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Biological Evaluation, Management Indicator Species, and Species of Local Concern Report

Landscape Vegetation Analysis (LAVA)

Medicine Bow National Forest, Albany and Carbon Counties, Wyoming

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Table of Contents

List of Tables

List of Figures

SUMMARY

Implementation of LAVA vegetation management will have variable effects on terrestrial wildlife of concern. Tree stands with high tree mortality and a sparse understory currently provide little habitat quality to terrestrial wildlife. Vegetation management in these stands will improve future habitat compared to what currently exists. Where management occurs in stands of green trees or with low to moderate amounts of tree mortality, habitat for wildlife dependent on old forest will decrease in quality or be removed for decades. Intermediate treatments that focus on areas that lack multi-story characteristics within old forest stands will benefit wildlife dependent on the dense cover typical of old forest stands in future decades.

Management of older aspen stands and older shrub stands can increase productivity in these stands and promote age class mosaics in areas where older age classes dominate the landscape. The productivity and age class diversity will benefit a variety of terrestrial wildlife over time.

Management can promote the existence and possible future small expansion of ponderosa pine and Douglas-fir. These are unique habitat features across the landscape. They are often a small component within lodgepole pine stands.

REGULATORY FRAMEWORK

Federal Laws and Regulations

Federal direction considered for the LAVA project included the Endangered Species Act (16 USC 1531 et. Seq.), the Migratory Bird Treaty Act (16 USC 703 et seq.), the National Forest Management Act (16 USC 1600 et. Seq), and Executive Order 13186.

Forest Service Direction

Forest Service Manual 2600 Wildlife, Fish, and Sensitive Plant Habitat Management including chapter 2670 Threatened, Endangered, and Sensitive Plants and Animals were reviewed for the LAVA project.

Forest Plan Direction

Numerous Forest Plan (USDA 2003) Standards and Guidelines influence the management of wildlife habitat on the Medicine Bow National Forest. Those most directly involved in habitat management include Standards and Guidelines for water and aquatics (p. 1-28, 29) and Biological Diversity (p. 1-31, 37, 38, 40, 41, 42, 43, 44). Forest Plan direction also includes the Southern Rockies Lynx Amendment (USDA 2008) and the Greater Sage-grouse Amendment (USDA 2015a).

ANALYSIS METHODOLOGY

Sources identified in the References section were used to determine the threats and limiting factors to wildlife species of concern, summarize responses of wildlife to the recent insect and disease outbreak, and determine the response of wildlife habitat to the insect and disease outbreak and to vegetation management practices. Impacts of the insect and disease outbreak to forested vegetation on the Medicine Bow NF were modeled based on remote sensing imagery and two seasons of field verification. This modeling was used to estimate the amount of tree mortality in each stand. Impacts to Greater

sage-grouse follow guidance in the recent Greater sage-grouse amendment (USDA 2015a). Impacts to Canada lynx are addressed in the separate Biological Assessment and follow the guidance in the Southern Rockies Lynx Amendment.

LAVA project was discussed and developed during regular meetings with federal, state, and local cooperating agencies including U.S. Fish and Wildlife Service and Wyoming Game and Fish Department.

AFFECTED ENVIRONMENT

Introduction

The purpose of the biological evaluation section of this report is to analyze and determine the likely effects of the alternatives on Forest Service sensitive species (FSM 2670.31-2670.32).

Forest Service policy requires that a review of programs and activities, through a biological evaluation (BE), be conducted to determine their potential effect on threatened and endangered species, species proposed for listing, and sensitive species (TEPS) (FSM 2670.3). Preparation of a Biological Evaluation as part of the NEPA process ensures that TEPS species receive full consideration in the decision-making process.

Existing Condition

The area to be managed with the Landscape Vegetation Analysis project (LAVA) is comprised of the Sierra Madre Range and Snowy Range in Wyoming on the Medicine Bow-Routt National Forests. These areas include sagebrush shrublands, mountain shrubs, aspen, lodgepole pine, and Engelmann spruce-subalpine fir, and small amounts of ponderosa pine, limber pine, and Douglas fir.

Table 1. Dominant Vegetation by Mountain Range (FSVeg)[1] Regardless of Tree Mortality

Sierra Madre							
FSVeg Species	ALL	Established[2]	Small	Medium	Large	Very Large	% of Mountain range
Forbs/ Grasses	135680						34
Barren	4044						1
Shrub	10810	0	428	4456	5926	0	3
Aspen	54869	1444	1980	33446	17914	85	14
Ponderosa pine (PP)	0						0
Douglas-fir (DF)	730			8	591	131	0

Lodgepole pine (LP)	132682	6826	11129	56250	58127	350	33
Spruce-fir (SF)	61102	3208	824	9362	44784	2924	15
Limber pine (LM)	56				56		0
Cottonwood	202			43	159		0

Snowy Range							
FSVeg Species	ALL	Established	Small	Medium	Large	Very Large	% of Mountain Range
Forbs/ Grasses	131743						23
Barren	4344						1
Shrub	3811		2640	977	194		1
Willow	13523		94	12470	959		2
Aspen	22916	704	2867	10925	8414	6	4
Ponderosa pine (PP)	162				19	143	0
Douglas-fir (DF)	6476	243		2693	3143	397	1
Lodgepole pine (LP)	269957	16067	52682	113848	86447	913	47
Spruce-fir (SF)	120223	6429	9850	20993	71038	11913	21
Limber pine (LM)	957		22	157	676	102	0
Rocky MTN Juniper	33			33			0
Cottonwood	255			53	69	133	0

1- acres shown are for NFS land only

2– Established $\leq$ 1”dbh, Small: 1-4.9”dbh, Medium: 5-8.9”dbh, Large: 9-15.9”dbh, very large: $\geq$ 16”dbh

Currently, a common habitat feature across this landscape is tree mortality from insects and disease. Most common among these is the mountain pine beetle outbreak. The pine beetle outbreak was widespread on the Forest, occurring from approximately 2002 to 2012. By 2016, no new mortality was detected in lodgepole pine or ponderosa pine. Generally, mortality within stands varies from 20% to 90% of the lodgepole pine. Sudden Aspen decline (SAD) has affected a lower but noticeable percentage of the aspen stands in this area. Also, spruce beetles have caused a lower but noticeable amount of mortality in spruce-fir stands. Approximately 240 acres of spruce mortality were detected in the general area in 2016, all within stands that had been previously infected. A total of approximately 120,000 acres in the area were impacted by spruce beetles since the late 1990’s.

Table 2. Estimated Mortality for all Forested Stands (from FSVeg).

Estimated Mortality (%)	Estimated Acres

0 - ≤20	367,696
21 - ≤40	220,906
41 - ≤60	48,766
>60	<1000

Table 3. Estimated Canopy Change for all Forested Stands (from FSVeg).

	Acres of Canopy Change		
Accounting Unit	**<30%**	**30-49%**	**≥50%**
Battle Pass	15,372	4,594	594
Big Blackhall	15,675	12,032	10,408
Bow Kettle	23,692	10,314	4,507
Cedar Brush	22,853	10,228	2,336
Fox Wood	34,077	15,937	14,630
French Douglas	23,941	8,440	5,387
Green Hog	15,454	8,103	3,780
Jack Savery	31,460	19,118	4,748
North Corner	10,550	8,317	7,202
Owen Sheep	6,139	3,777	3,615
Pelton Platte	6,439	4,050	4,481
Rock Morgan	19,459	10,098	2,972
Sandy Battle	32,765	8,923	3,922
West French	25,576	12,931	7,121

These habitat changes have created an immediate (1-10 years) and substantial loss of mature and older-aged conifer forest in stands where tree mortality was high. Generally, there is a large increase in understory production by existing grasses, forbs, and shrubs but little change in understory plant

diversity where pine beetles have killed a large portion of lodgepole within a stand (Stone and Wolfe 1996). Time since death of beetle-killed trees is an important factor determining usefulness of these trees for wildlife (Chan-McCleod 2006): wildlife species that require mature forest cover are less affected in 3 to 5 years; as the stand continues to break up over time it becomes less favorable to mature forest species; wildlife species that thrive in open, edge, or coarse woody debris habitat benefit in the mid and long term; and salvage harvesting of beetle-killed stands might rejuvenate stands more quickly.

Where tree mortality was moderate, some habitat qualities were enhanced since substantial live trees remained but the amount of large snags and coarse woody debris increased from the insect and disease outbreak. Many native species, from microorganisms to top carnivores rely on snags and coarse woody debris as important and unique habitat components (USDA 2003, Appendix D pp. 78-85). Approximately 964,000 acres of stands experienced $\leq$60% tree mortality. Snags, large snags, and large coarse woody debris have not always been a common characteristics across the Forest. Earlier management actions retained few snags and little coarse woody debris (USDA 2003, Appendix D pp. 78-85). Some type of timber harvest, and a supporting road network, has occurred over approximately 132,937 acres (12.3%, USDA 2003 p. 3-150) of the forested habitat across the Forest over 50 years. Dillon et al. (2003) found that harvested stands had lower snag density and less coarse woody than the historic range of variability. Where management actions have been extensive, the range of decay in retained snags or the lack of retaining the largest snags may reduce habitat effectiveness for the community of snag dependent wildlife (USDA 2003, Appendix D). Of course, this condition changed abruptly with the recent pine beetle outbreak. Large snags and coarse woody debris are now abundant across the Forest in areas that did not receive vegetation management in the last 50 to 70 years. Often, fires, insect and disease outbreaks, or blowdown are the events that provide snags and coarse woody debris in the forest (USDA 2003, Appendix D pp. 78-85).Where tree mortality was severe, habitat quality often became unsuitable. Approximately 1000 acres of stands experienced >60% tree mortality.

Martin et al. (2006) studied wildlife and habitat changes in predominantly lodgepole pine stands before and during a pine beetle outbreak in British Columbia. They found a high degree of spatial variability in beetle impacts with 82% to 100% of lodgepole trees within stands showing signs of beetle attack but total conifer mortality ranging from 5% to 82%. They surmised this variability was similar to patterns for wildfires and these spatial and temporal patterns were important in maintaining forest biodiversity.

Stone (1995) noted 10 to 25 fold increases in understory biomass for moderate tree mortality stands (51-75% dead) and high tree mortality stands (>75% dead), respectively, compared to lodgepole stands unaffected by pine beetles. Plant diversity was highest in moderate mortality stands but new plant species were not relatively abundant, so evenness was not substantially increased. Horizontal cover was highest in stands with >40% tree mortality. The author did not detect any noticeable change in coarse woody debris 10 years after the outbreak but did note that stands affected by pine beetles 30 years previously had significant amounts of downed wood. The author noted that most habitat diversity and productivity occurred in stands with moderate tree mortality (51 – 75% dead) and these stands had the greatest abundance of birds and mammals.

Stone (1995) summarized the ecology of mountain pine beetle outbreaks in the following manner: "*Outbreaks of MPBs generally affect older, larger trees (Cole and Amman 1969), but in "intense" epidemics, saplings may also be killed. The average age of LPP trees in outbreak stands is 80 years (McGregor and Cole 1985), but beetles usually spread from the older trees in the stand. Thus, outbreaks of MPB usually produce an immediate shift in the age and size distribution of the residual stand toward younger and smaller trees (Crookston and Stark 1985)…*

Recurrent MPB outbreaks result in an accumulation of standing dead and downed wood. The increase in snag density is inherent to this disturbance type. Density of downed wood varies with percent tree mortality following outbreaks and increases as standing dead boles fall. Beetle-killed LPP trees often persist 20 to 40+ years on the ground (Brown 1975). Recent fires in Yellowstone National Park demonstrated the importance to forest ecosystems of fuel accumulation primarily from beetle-killed timber. Standing dead and downed wood resulting from MPB epidemics increase the probability and intensity of stand-replacing fires (Crookston and Stark 1985, Petennan 1978), which often regenerate LPP (Peterman 1978).

Patterns of forest succession are altered by outbreaks of MPB. Mountain pine beetles may retard or accelerate progress toward a specific stage in a successional sequence. The disturbance may trigger a stand-replacing fire, or, alternatively, bring about the release of shade-tolerant understory conifers (Waters 1985)."

Stone continued that a mountain pine beetle epidemic differs from other types of disturbance because: (1) larger and older trees are selectively killed by the disturbance agent; (2) the understory and soil layers are not directly affected by the disturbance agent; (3) the return of nonvolatile nutrients to the soil and the response of vegetation production are slower than that which would occur following a stand-replacing fire; (4) it hastens successional progress towards a climax when lodgepole pine is seral; (5) repeated epidemics shift the stand structure from even-aged to uneven-aged; (6) disturbance severity can range widely with environmental conditions (elevation, climate, topography), but overstory tree mortality is typically moderate, removing approximately 50% of the canopy cover and basal area in a few years; and (7) widely distributed gaps in the forest canopy are created when at least six to seven large trees in proximity to each other succumb during the epidemic.

Stone (1995) noted "The presence and relative dominance of aspen in the understory communities of many disturbed stands with intermediate mortality are intriguing because of the consequences for the future development and management of disturbed stands. A reoccurrence of epidemic mountain pine beetle activity in stands where lodgepole pine is persistent in 20-30 years could give aspen a competitive advantage in the midstory layer, allowing it to dominate lodgepole pine in the overstory for a number of years.

Dhar et al. (2016) indicated "...the majority of studies conclude that the occurrence of MPB attacks in most of the pine dominated stands results in more structurally and compositionally diverse stands, leading to multiple successional pathways different from those developed after logging or fire…Considering the species composition, beetle attacked forests are undergoing substantial

conversion—moving from lodgepole pine to more shade-tolerant species such as subalpine fir…followed by low-to-moderate shade-tolerant species such as lodgepole pine and Douglas-fir".

Malcolm (2012) summarized the findings of researchers following the insect outbreak in Colorado and southern Wyoming. He summarized that tree regeneration was abundant in beetle-killed stands, subalpine fir recruitment was high, aspen increased, surviving understory trees had greatly increased growth rates, and the structurally complexity and tree species diversity increased.

The impacts of the pine beetle outbreak to wildlife are variable (i.e. Saab et al. 2014). Insect outbreaks, even the recent extensive pine beetle outbreak, are heterogeneous and vary by frequency, duration, severity, and spatially and temporally regionally and in small areas. Likewise, impacts can vary for a species spatially, in severity, and over time. Impacts among species can vary by type of habitat change, extent of habitat change, and associated changes in competition, predation, or food supply.

A wide array of birds and mammals rely on forests maintained by large-scale beetle outbreaks and fire in western North America (see Saab et al. 2014). Bark beetle caused tree mortality creates snags and logs that provide nesting, roosting, refugia from predation, and foraging substrates, promotes understory vegetation, and provides pulses of insect prey. These changes also reduce mature forest and tree cover and cone seed resources for other wildlife. Several years after the outbreak subsides, increased light and nutrients promote understory herbaceous and shrub growth that benefits wildlife associated with early seral habitats.

Saab et al. (2014) summarized this variability of bird and mammal responses to mountain pine beetle outbreaks from numerous studies. Most studies occurred during or immediately after pine beetle outbreaks so wildlife responses to longer term habitat changes were often not well characterized. Results varied in several instances and could have been related to intensity or spatial extent of the beetle outbreak or the stage of the outbreak in which a study occurred, for example. Authors summarized that northern goshawks showed no significant change while individual prey species showed variable responses, suggesting prey would be available throughout corresponding beetle outbreak stages. Cavity nesters generally benefitted from the increase in snag numbers. Bark drilling woodpeckers exhibited the most positive responses, while omnivorous woodpeckers demonstrated weaker responses or nonsignificant responses among studies. Shrub nesting birds generally displayed a positive response several years after beetle outbreaks, likely a response to increased understory growth. Bark gleaners, like the brown creeper, were weakly benefitted by the outbreaks but responses varied among studies. Other species of interest olive-sided flycatcher and golden-crowned kinglet displayed variable results. Birds characterized as pine seed consumers showed no significant response but studies were completed before existing pine seed abundances were depleted.

Holmes et al. (2009) found even budworm specialist species varied in the timing of their positive response, the magnitude of their positive response, and the timing of their declining response to a spruce budworm outbreak. They concluded all bird species positively affected by the insect outbreak began to decline before the height of the insect outbreak, presumably due to the extent of negative habitat changes having a greatly influence than the superabundant food supply. They found some

negatively affected bird species declined quickly while other negatively affected species declined more gradually.

Drever et al. (2009) evaluated 4 guilds of insectivore birds (aerial, bark, foliage, and ground), an omnivore guild, and herbivore guild before and during the early years of a pine beetle outbreak in British Columbia. Bark insectivores responded quickly and positively to the sharp increase in beetle-infested lodgepole pine trees. Foliage gleaners positively responded in a weak manner. Omnivores and herbivores showed no relationship to the first years of the outbreak.

Similar results were found by Bull (1983) in lodgepole pine stands with variable stages of pine beetle mortality. Woodpeckers were most abundant in stands with active beetle infestation to stands dead for 2-5 years. Foliage gleaners were most abundant in stands of live, green trees and least abundant in stands that had been dead 2-5 years.

Martin et al. (2006) found richness and abundance of bird species remained stable during the build-up of a pine beetle outbreak. However, abundance of individual species varied widely. Authors noted that bird abundance appeared to decline when conifer mortality reached 50%. In addition, the authors found that red squirrel abundance also declined with progress of the outbreak. Large, old aspen was very disproportionately used for cavity-nesting with 96% of nests found in these trees while aspen comprised only 15% of the large trees in the area.

Snowshoe hares exhibited mixed results among studies reviewed (Saab et al. 2014). In the Snowy Range of the Medicine Bow NF, red-backed vole abundance was not significantly related to percent dead lodgepole (range 0 – 30%) or percent dead spruce (range 0 – 60%). However, voles increased with increases in coarse woody debris. Red squirrels generally declined in response to the beetle outbreak, perhaps due to reductions in cone seeds for food and reduced canopy cover used to evade predators. This red squirrel decline included a study in the Coon Creek watershed on the Medicine Bow NF where tree mortality for lodgepole pine and Engelmann spruce >30 cm dbh were 60-100% depending on size class. Saab et al. (2014) suggested responses by ground-dwelling small mammals might be more pronounced if studies had been conducted longer after the outbreaks (> 6 years) when snags began to fall to increase coarse woody debris and understory plant productivity increased.

Saab et al. (2014) also noted there was a lack of research on broad scale outbreak impacts to wildlife requiring large landscapes such as lynx, bears, and goshawks. Authors were unsure if these species could compensate for landscape scale changes.

Stone studied lodgepole pine stands in northern Utah 3 – 10 years after a pine beetle epidemic. Stands ranged from unaffected by pine beetles to 95% tree mortality. He found bird abundance and diversity was highest in stands with moderate tree mortality (51-75% dead), even for species that relied on live pine trees for obtaining food. Stone found goshawks were most often observed in stands with little or no tree mortality. He determined small and medium sized mammals were most abundant and diverse is stands with moderate mortality. Red-backed voles were most common in stands that experienced moderate tree mortality and experienced a previous (1960) pine beetle outbreak. He found red squirrels were more abundant in stands with low tree mortality, were also found in stands with

moderate tree mortality, but were absent from stands with high mortality. This species appears to be closely tied to canopy foliage. Snowshoe hare fecal pellet abundance increased to approximately 55% tree mortality, then declined. The author's results suggested this was related to understory plant diversity rather than grass abundance. Stone concluded that understory biomass, diversity and heterogeneity, and foliage height diversity were the habitat characteristics that explained wildlife distribution in pine beetle impacted stands.

Johnson et al. (2015) evaluated red squirrel responses to decades earlier patch cutting and a recent pine beetle outbreak in the Coon Creek area of the Medicine Bow NF. Results indicated red squirrels were more likely to colonize sites with higher basal area before and after the beetle outbreak but colonization was much lower after the outbreak since the outbreak greatly reduced basal area. Basal area is related to abundance of conifer cone seeds, which are specifically required by red squirrels as a food source. Higher basal area also creates cool microsites for middens. Similarly, extinction probability declined with increased snag density up to 5 snags/ha (50/ac) with extinction probability much lower before the outbreak than after the outbreak at the same snag density. Red squirrel occupancy did not decline as much as expected after the beetle outbreak. It was speculated that the decline might be reduced because some lodgepole and spruce cones were still available so recently after the outbreak, previously harvested stands produced a small amount of cones, and subalpine fir was providing some cone seeds because this tree species had not yet been as severely impacted by insects and disease.

Steventon and Daust (2009) reviewed research on American marten habitat and harvest impacts. Then, they developed a comparative model to estimate the effects of the pine beetle outbreak and several harvest methods on likelihood of maintaining different marten population levels over 140 years as measured in female home ranges. They surmised that the beetle outbreak and initial salvage harvest for approximately 20 years caused a substantial marten population decline. Then, management options produced variable probabilities of achieving several long-term marten population recovery levels. Implementing partial cutting (30-70% overstory retention) for 50%, 33%, and 0% of the estimated annual harvest had the greatest to least, respectively, average long-term marten population levels. Reducing the annual harvest rate had the second greatest impact on marten population levels in the long term. Retaining the understory during operations had the next greatest impact. Maintaining the status quo of clearcutting with <20% mature tree retention resulted in the lowest long-term marten population levels.

Aspen occupies more than 75,000 acres across the LAVA analysis area, with more than 58,000 of those acres occurring in the lower elevations of the Sierra Madre Range. Aspen stands are older than was typical of the past and increased amounts of fir have invaded the stands. Montane riparian areas have less aspen as aspen has been crowded out by conifers. Understory herbaceous vegetation is reduced because of the increase in canopy cover (USDA 2003, App. D p. 24).

Some shrublands have become more uniform and older than might occur naturally (USDA 2003, App. D p. 44). Some shrublands such as serviceberry and mountain mahogany are scattered in distribution, often moderately or more severely browsed, and often more represented in older age classes. Antelope bitterbrush is more widely distributed, displays more variable browsing levels, and has greater age class variability due to past vegetation treatments. Sagebrush shrublands vary from the uniform, older stands

to age class mosaics created by the more than 25,000 acres of shrubland treatments and wildfires since 1970, including more than 17,000 acres since 1990.

Desired Condition

Desired conditions include regeneration of lodgepole stands that have high tree mortality and a poorly developed understory in the near future. These stands do not provide quality habitat for many terrestrial wildlife of concern. Desired conditions also include regeneration of aspen over the next 15 years to provide age class diversity and maintenance of some aspen stands over the next 15 years through conifer removal. Desired conditions for Greater sage-grouse include promotion of habitat characteristics beneficial to sage-grouse seasonal habitats as described in the Greater sage-grouse amendment (USDA 2015a) over the life of the amendment.

Proposed Action

The proposed action is described in detail in the Draft EIS. To summarize, the proposed action includes 95,000 acres of stand initiation or even-aged treatment methods. Stand initiation will occur where mortality is >50%, or moderate to high levels of insects and disease occur, or Culmination of Mean Annual Increment (CMAI) has been reached. These diseases can include mistletoe infection. The estimates of CMAI opportunities in the Forest's vegetation database range from 4,957 acres to 82,866 acres based on estimates for size and age class of trees and estimates of low tree mortality. For the purpose of this analysis, it will be assumed that as many as 82,866 acres could be treated based on CMAI. This is an unlikely scenario but provides a sideboard for analysis.

Proposed action includes 165,000 acres of various uneven-aged or intermediate treatments. These treatments often occur in stands with 30-49% mortality or with low levels of insects and disease.

Proposed actions also include 100,000 acres of more variable treatments. These include treatment of shrublands and grasslands or treatment of forested stands when mortality is <30% or with low levels of insects and disease.

Proposed actions also include 600 miles of temporary roads. Temporary roads will be obliterated following design criteria methods identified in the draft EIS. Obliteration will occur within 3 years of project use.

SPECIES CONSIDERED FOR ANALYSIS

All Region 2 terrestrial wildlife sensitive species were considered for inclusion in analysis (Table 4). Those sensitive species that may be affected directly, indirectly, or cumulatively by proposed actions

were selected for further analysis. Other species were not selected for further analysis because: 1) suitable habitat, elevation, or range/distribution does not exist for the species in the project area, including those identified in USDA (2016) or 2) the type or intensity of the activity in the proposed actions is expected to have no impact to the species or its habitat. **Note: Amphibian, fish, and plant species are considered in separate biological evaluations.**

A pre-field review was conducted of available information to assemble occurrence records, describe habitat needs and ecological requirements, and determine whether field reconnaissance is needed to complete the analysis. Forest Service records (NRIS Wildlife Database), Forest songbird MIS monitoring results, the Atlas of Birds, Mammals, Amphibians and Reptiles in Wyoming (Cerovski et al. 2004), A conservation plan for bats in Wyoming (Hester and Grenier 2005), Partners in Flight (Nicholoff 2003), the Biological Evaluation and FEIS for the Forest Plan revision (USDA 2003), the USFS Region 2 websites for Species Evaluations and Rationale and Species Conservation Assessments (USDA 2003-2015) were examined. The Region 2 website also includes a table of sensitive species by the Forest where these species occur. This table (USDA 2016) was also used to examine sensitive species for further evaluation.

Some existing condition and limiting factors information for each sensitive species were extracted from the FEIS Biological Evaluation (Appendix I) for the revision of the Medicine Bow Land and Resource Management Plan. This Biological Evaluation is identified as USDA (2003) throughout this analysis. Most other existing condition and limiting factors information was gathered from the Species Conservation Assessments (2003-2015).

No further analysis is needed for species that are not known or suspected to occur in the project area, and for which no suitable habitat is present. The following table documents the rationale for excluding a species. If suitable but unoccupied habitat is present, then potential effects are evaluated.

Table 4. Region 2 Sensitive Species (Terrestrial Wildlife)

Common Name	Habitat*	Selected
BIRDS		
American bittern *Botaurus lentiginosus*	Marshes. Does not exist on Forest (USDA 2016).	No-1
Trumpeter swan *Cygnus buccinators*	Marshes, lakes, rivers. Does not exist on Forest (USDA 2016).	No-1
Harlequin duck *Histrionicus histrionicus*	Rivers, lakes in mountainous areas. Does not exist on Forest (USDA 2016).	No-1
Bald eagle Haliaeetus leucocephalus	Lakes, Rivers.	No-2, habitat not affected by proposed activity. No proposed action near known nest sites.
Northern goshawk *Accipiter gentilis*	SF,AS,LPP,RIP	**YES**

Common Name	Habitat*	Selected
Ferruginous hawk *Buteo regalis*	MS,FM,SS, 4500 – 7500 ft elevation (Nicholoff 2003)	No-1, beyond elevation range
American peregrine falcon *Falco peregrinus anatum*	RO 50-200ft high, SS near RO, 4500-9000 ft elevation (Nicholoff 2003)	No-2, habitat not affected by proposed activity
Northern harrier *Circus cyaneus*	Grassland, Marsh, SS near water, <2400m (Smith et al. 2011)	No-2, habitat not affected by proposed activity
Columbian sharp-tailed grouse *Tympanuches phasianellus columbianus*	MS west of Continental Divide	**YES**
Greater prairie-chicken *Tympanuchus cupido*	Grasslands. Does not exist on Forest (USDA 2016).	No-1
Greater sage-grouse *Centrocercus urophasianus*	SS	**YES**
White-tailed ptarmigan *Lagopus leucurus*	Alpine willow, grasses, krummholtz. Currently considered extirpated on the Medicine Bow (USDA 2003, Hoffman 2006 p. 15).	No-1
Mountain plover *Charadrius montanus*	Grasslands. Does not exist on Forest (USDA 2016).	No-1
Long-billed curlew *Numenius americanus*	Grasslands. Does not exist on Forest (USDA 2016).	No-1
Black tern *Chlidonias niger*	WET. Grassland wetlands $\leq$ 2000m elevation. Does not exist on Forest (Naugle 2004).	No-1
Burrowing owl *Athene cunicularia*	Grasslands. Does not exist on Forest (USDA 2016).	No-1
Boreal Owl *Aegolius funereus*	SF,LPP	**YES**
Flammulated owl *Psiloscops flammeolus*	AS, PP stands in southern portion of Sierra Madres	**YES**
Short-eared owl Asio flammeus	SS, grasslands, marshes. Might occur only on the Laramie Peak unit.	No-1
Black swift *Cypseloides niger*	Wet cliff faces. Does not occur on Forest (Wiggins 2004)	No-1
Lewis' woodpecker *Melanerpes lewis*	PP. Occurs on the Laramie Peak unit	No-1
Black-backed woodpecker *Picoides arcticus*	SF,PP and recently burned conifer forest. Does not exist on Forest (USDA 2016).	No
Olive-sided flycatcher *Contopus cooperi*	SF,LP,WET,FM	**YES**
Purple martin *Progne subis*	Known to occur in AS on west side of Continental Divide.	**YES**
Loggerhead shrike *Lanius ludovicianus*	Grassland w/shrubs <8000 ft. (Wiggins 2005)	No-2, habitat not affected by proposed activity
Brewer's sparrow *Spizella breweri*	SS	**YES**

Common Name	Habitat*	Selected
Cassin's sparrow *Aimophila cassini*	Grasslands. Does not exist on Forest (USDA 2016).	No-1
Grasshopper sparrow *Ammodramus savannarum*	Large grasslands and open sagebrush grasslands (Slater 2004)	No-1. Habitat does not exist in project area.
Sage sparrow *Amphispiza bellii*	SS below 6500 ft. (Nicholoff 2003)	No-2, habitat not affected by proposed activity
McCown's longspur *Calcarius mccownii*	Grasslands. Does not exist on Forest (USDA 2016).	No-1
Chestnut-collared longspur *Calcarius ornatus*	Grasslands. Mixed and shortgrass prairie; avoids shrublands (Sedgwick 2004)	No-1. Habitat does not exist on Forest
MAMMALS		
Rocky Mountain Bighorn Sheep *Ovis canadensis canadensis*	Shrublands, Rock outcrops, Alpine. 3 herds on Forest.	**YES**
Desert bighorn sheep *Ovis canadensis nelson*	Shrublands, Rock outcrops, Alpine. Does not exist on Forest (USDA 2016)	No-1
Pygmy shrew *Sorex hoyi*	Wetland edges in SF above 9000 ft. (Spencer and Pettus 1966).	**YES**
Fringed myotis *Myotis thysanodes*	Roosts in RO, Mines, Caves, snags at 1200-2100 m (Keinath 2004). Forages in PP, oak, shrublands, pinyon/juniper (Keinath 2004).	No-2. Habitat not affected by proposed action
Spotted bat *Euderma maculatum*	Juniper shrub,desert sagebrush grasslands. Does not exist on Forest (USDA 2016).	No-1
Townsend's big-eared bat *Corynorhinus townsendii*	Caves, mines, buildings, bridges in close proximity to summer foraging habitat (over live canopy, shrublands) (Gruver and Keinath 2006) (Hester and Grenier 2005).	No-2. No suitable roost sites in analysis area
Hoary bat *Lasiurus cinereus*	Roosts in conifer and deciduous foliage.	**YES**
Black-tailed prairie dog *Cynomys ludovicianus*	Grasslands. Does not exist on Forest (USDA 2016).	No-1
White-tailed prairie dog *Cynomys leucurus*	Colony at Six-Mile/Platte River.	**YES**
Gunnison's prairie dog *Cynomys gunnisoni*	Dry grasslands at high altitudes. Does not exist on Forest (USDA 2016).	No-1
Wyoming pocket gopher *Thomomys clusius*	SS, Grassland. Does not exist on Forest (Keinath and Beauvais 2006).	No-1
Water vole *Microtus richardsoni*	Alpine, subalpine, and foothills riparian. Does not exist on Forest (USDA 2016).	No-1
Swift fox *Vulpes velox*	Grasslands. Does not exist on Forest (USDA 2016).	No-1
Kit fox Vulpes macrotis	Grasslands. Does not exist on Forest (USDA 2016).	No-1

Common Name	Habitat*	Selected
River otter *Lontra canadensis*	Rivers	No-2. Habitat not affected by proposed activity
American marten *Martes americana*	SF,LPP	**YES**
North American wolverine *Gulo gulo*	SF,AL,LPP,RO	No-1. Aubry et al. (2007); www.fws.gov\wyominges\pages
American hognosed skunk *Conepatus leuconotus*	Sparsely timbered or brushy areas. Does not exist on Forest (USDA 2016).	No-1
AMPHIBIANS		
Boreal toad *Anaxyrus boreas boreas*	Five known breeding sites in the Snowy Range.	Addressed in Fisheries BE
Columbia spotted frog *Rana luteiventris*	Bighorn Mountains population. Does not exist on Forest (USDA 2016).	No-1
Northern leopard frog *Lithobates pipiens*	Wetlands. Known to occur on Sierra Madre and Snowy Range to 2700m (Smith and Keinath 2007)	Addressed in Fisheries BE
Plains leopard frog *Lithobates blairi*	Wetlands. Does not exist on Forest (USDA 2016).	No-1
Wood frog *Lithobates sylvatica*	Known to occur in the Snowy Range (Muths et al. 2005).	Addressed in Fisheries BE
REPTILES		
Desert massassauga rattlesnake *Sistrurus catenatus edwardsii*	Grasslands. Does not exist on Forest (USDA 2016).	No-1
Black Hills redbelly snake *Storeria occipitomaculata pahasapae*	FM in Black Hills. Does not exist on Forest (USDA 2016).	No-1
MOLLUSCS		
Rocky Mountain capshell *Acroloxus coloradensis*	Littoral zones of rocky oligotrophic to mesotrophic lakes <9400 ft. Known only from CO, MT (Anderson 2005, Sovell 2006)	No-1
Pygmy mountainsnail *Oreohelix pygmaea*	Known only to the Bighorn NF (USDA 2013).	No-1
Cooper's Rocky Mountainsnail *Oreohelix strigosa cooperi*	Known only to Black Hills and Bighorn NFs (USDA 2016)	No-1
INSECTS		
Arapahoe snowfly *Capnia Arapahoe*	Does not exist on Forest (USDA 2016).	No-1
Susan's purse making caddisfly *Ochrotrichia susanae*	WET. Does not exist on Forest (USDA 2016).	No-1
Ottoe skipper *Hesperia ottoe*	Mixed grass prairie. Does not exist on Forest (Selby 2005).	No-1
Hudsonian emerald *Somatochlora hudsonica*	Boggy ponds near slow flowing water near trees. Known to occur in the Snowy Range (Packauskas 2005)	**YES**
Regal fritillary *Speyeria idalia*	Prairie grasslands, range extending into e. WY (Selby 2007).	No-1

Common Name	Habitat*	Selected
Nokomis fritillary *Speyeria nokomis nokomis*	WET. Known range south and west of Wyoming. Does not exist on Forest (USDA 2016).	No-1
Monarch butterfly *Danaus plexippus plexippus*	River bottoms in the west, <2000m (Dingle et al. (2005)	No-1
Western bumblebee *Bombus occidentalis*	Grasslands with wild flowering plants; croplands. Mountain meadows with flowering plants.	**YES**

The Medicine Bow Plan identifies 7 terrestrial wildlife MIS (Management Indicator Species) (Table 5). MIS in the Medicine Bow Plan will be evaluated for further analysis. Rationale for use as an MIS at the Forest level and habitat used is included in Table 6 and was taken from the FEIS for the Plan. MIS with no habitat in the analysis area (AA) need no further analysis because the project will not impact them, their habitat, or their Forestwide population trends. Fish MIS are addressed in the aquatic resources MIS report.

Table 5. Management Indicator Species for the Medicine Bow Forest Plan

Species	**Indicator of:**	**Habitat Used**	**Habitat in the Analysis Area**
Snowshoe hare *Lepus americana*	Adequacy of habitat to support prey species of top predators	Habitats with dense understory	Y
American marten *Martes amercana*	Spatial pattern or fragmentation-perforation at landscape scale and coarse woody debris	SF,LPP	Y
Northern goshawk *Accipiter gentilis*	Late seral lodgepole and aspen	AS,LPP	Y
Golden-crowned kinglet *Regulus satrapa*	Fragmentation within a stand	SF, LPP	Y
Three-toed woodpecker *Picoides tridactylus*	Snags, old forest, recent forest burns	SF, LPP	Y
Lincoln's sparrow *Melospiza lincolnii*	Riparian zone, herbivory in willow community	RIP	Y
Wilson's warbler *Wilsonia pusilla*	Riparian zone, herbivory in willow community	RIP	Y
Common trout	Water quality	Addressed by Fisheries Biologist	

**AL-alpine, AS-aspen, FM-forest meadow, LPP-lodgepole pine, SS-sagebrush shrub, MS-mountain shrub, PP-ponderosa pine, RIP-riparian, RO-rock/cliff/cave, SF-spruce-fir, WET-wetland, PJ-Pinyon-Juniper*

Table 6. Summary of initial MIS analysis and identification of species for comprehensive analysis

Common Name of MIS	Management Issue/Habitat Assemblage	Species/ Habitat Present in Analysis Area?	Management Issue or habitat assemblage pertinent to the project?	Rationale	Species Selected for more detailed analysis?
Snowshoe hare	Adequacy of habitat to support prey species of top predators	**Yes**	**Yes.** The decision will affect habitat used by the species.	Effects of vegetation mgt. should be analyzed.	**Yes**
American marten	Spatial pattern or fragmentation-perforation at landscape scale and coarse woody debris	**Yes**	**Yes.** The decision could affect fragmentation-perforation at the landscape scale	Effects of vegetation mgt. should be analyzed.	**Yes**
Northern goshawk	Condition and biodiversity of late seral lodgepole and aspen	**Yes**	**Yes.** The decision will affect late seral lodgepole.	Effects of vegetation mgt. should be analyzed.	**Yes**
Golden-crowned kinglet	Fragmentation within a stand	**Yes**	**Yes.** The decision could affect canopy cover within a stand.	Effects of vegetation mgt. should be analyzed.	**Yes**
Three-toed woodpecker	Snags, old forest, recent forest burns	**Yes**	**Yes.** The decision could affect old forest and could affect snags.	Effects of vegetation mgt. should be analyzed.	**Yes**
Lincoln's sparrow	Riparian zone, herbivory in willow community	**Yes**	**No.** The decision will not affect willow riparian zone.	No vegetation mgt. in riparian zone.	No
Wilson's warbler	Riparian zone, herbivory in willow community	**Yes**	**No.** The decision will not affect willow riparian zone.	No vegetation mgt. in riparian zone.	No
Common trout	Water quality	**Addressed in Fisheries biologist report**			

There are 4 Species of Local Concern for the Forest. Rocky Mountain bighorn sheep is already addressed as a Sensitive Species. The remaining species are American pika, brown-capped rosy finch, and brown creeper. Habitat for pika occurs in talus slopes/outcrops of rock above 8000 ft. set in tundra or broken subalpine forest. There is pika habitat in the analysis area but the proposed actions will not occur within pika habitat or affect the pika. No further analysis is necessary.

The brown-capped rosy finch occurs in the Snowy Range above timberline in low grass, cushion plant and lichen encrusted bare rock near Medicine Bow Peak. Threats to this finch include isolation and disturbance associated with recreation. There is brown-capped rosy finch habitat in the analysis area but the proposed actions will not occur within brown-capped rosy finch habitat or affect the brown-capped rosy finch. No further analysis is necessary.

The brown creeper occurs in the analysis area. It occurs in large blocks of old spruce-fir and lodgepole forest. Threats include forest management that alters the structure of its preferred mature and old

growth forest with reductions in basal area of lives trees, canopy closure, and the quantity, quality, and distribution of suitable snags. This habitat will be affected by the proposed actions. Further analysis is necessary.

Project Design Features

Final Design Features are identified in the Draft EIS and are incorporated in the analysis for individual species as appropriate.

ANALYSIS OF ALTERNATIVES FOR EACH SPECIES

Effects to Brown Creeper – Species of Local Concern

Existing Condition

Potential brown creeper habitat across the Forest corresponds to spruce-fir forest of structural stages 4A through 4C and lodgepole of stages 4B and 4C. There are >173,000 acres of lodgepole pine and spruce-fir habitat in the analysis area.

Brown creeper became a species of local concern with the Forest Plan revision completed December 2003. Brown creepers are difficult to detect due to their inconspicuous nature. They are sufficiently uncommon that only 3 have been detected on any of the 6 BBS routes on or adjacent to the Forest since the 1st route was surveyed in 1968. Current data are collected in coordination with the Bird Conservancy of the Rockies (http://rmbo.org/v3/avian/ExploretheData.aspx). Monitoring data collected to date is provided in the table below. Detection declines since 2008 could reflect the changes in sampling design initially and also likely to reflect declines in canopy cover as needles and limbs have fallen off beetle-killed lodgepole, thus reducing brown creeper habitat over time.

Table 7. Brown Creeper Monitoring across the Forest

Year	No. Observed
2008	18
2009	1
2010	33
2011	12
2012	21
2013	7

2014	11
2015	9
2016	2

No Action Alternative

Direct and Indirect Effects

The pine beetle outbreak created a short-term dramatic improvement in habitat quality by creating trees and snags with loose bark and by providing an abundance of prey insects under the bark. Resulting snags would provide nesting habitat as long as sufficient density of live or dead canopy and limbs remained to prevent nest sites from being directly exposed to weather elements (see Wiggins (2005). These areas could still be used for some foraging in later years as long as snags and dying trees will support sufficient insect prey. However, eventually, stands with high tree mortality are lost as suitable habitat through natural stand decline. Forest regeneration could produce nesting habitat again in 80-100 years. Normal prey abundance is not likely to return for decades after the stands have become unsuitable.

Stands with lower amounts of tree mortality will be retained as suitable habitat. Saab et al. (2014) summarized that variations among beetle outbreak studies had nonsignificant to positive effects to brown creeper. Lower tree mortality maintains insect prey abundance, maintains some canopy cover, and provides trees with loose bark for nesting sites.

Habitat with lower tree mortality will also improve in quality over time. The beetle-killed trees in these stands will increase coarse woody debris over time. Understory productivity will increase, advanced regeneration growth rate will increase, and subalpine fir trees will become a larger component of these stands (Dhar et al. 2016, Malcolm 2012). Subalpine fir trees have limbs that reach to the ground, providing additional horizontal cover. In comparison, maturing lodgepole pine trees lose ground level limbs.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to wildlife habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The pine beetle outbreak detailed earlier created a short-term dramatic improvement in habitat quality by creating trees and snags with loose bark and by providing an abundance of prey insects under the bark. Resulting snags would provide nesting habitat as long as sufficient density of live or dead canopy and limbs remained to prevent nest sites from being directly exposed to weather elements (see Wiggins (2005). These areas would still be suitable habitat where tree mortality is low to moderate. Habitat would no longer be suitable where tree mortality is high.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce brown creeper habitat if they occur in stands with low or moderate tree mortality.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Brown creepers have been found to avoid habitat within 100m of roads (Hutto 1995). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface

replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Modified Proposed Action

Direct and Indirect Effects

Wiggins (2005) summarizes, "the primary factor linked to local declines in brown creepers has been the loss and degradation of mature and old-growth forests, primarily due to logging… in the following ways: 1) reducing the overall availability of suitable nesting and foraging habitat; 2) increasing the distance between suitable nesting/foraging habitat patches (i.e., habitat fragmentation); and 3) decreasing reproductive success by lowering prey availability." Reviews by Saab et al. (2014) suggest stands with lower tree mortality are still suitable brown creeper habitat. Even without vegetation management, many beetle-impacted stands would eventually become unsuitable where tree mortality is higher and density of live or dead canopy and limbs is reduced. These features prevent nest sites from being directly exposed to weather elements (see Wiggins (2005)). In areas of extensive tree mortality, habitat for prey species and, therefore, prey abundance has declined as bark falls from trees and canopy cover is reduced.

The Forest's vegetation database suggests 4957 to 82,866 of the 95,000 acres of stand initiation treatment could be implemented because stands have reached CMAI. Field assessments in preparation for treatment will verify the final acreage of CMAI stands. These stands are considered suitable habitat. Stand initiation treatment and associated temporary roads will eliminate habitat in stands with moderate insect/disease levels or that have reached CMAI. Regenerated areas will provide foraging habitat in several decades when mature trees again provide habitat for insect prey. Nesting habitat will be produced in 80-100 years when trees or snags with loose bark are created in these areas.

Stand initiation management and associated temporary roads will have little impact where tree mortality is high. These stands are not suitable habitat. Tree mortality is too high to provide canopy cover or abundant insect prey habitat. Regeneration will promote future foraging habitat in several decades and nesting habitat in 80-100 years.

The decline in habitat will be directly related to the proportion of treatments in moderate insect/disease stands or CMAI stands. Secondly, regeneration of foraging and nesting habitat will be delayed for stands that occur in the Forest's WUI areas. There are no Forest Plan requirements to retain snags or large recruitment trees in WUI areas. Snags and large trees are important components of brown creeper habitat. There are about 360,000 acres of potential treatment opportunities within these WUI areas.

Intermediate and "other" treatments and associated temporary roads will reduce habitat quality. These stands have lower levels of tree mortality and are often the spruce-fir stands that provide the best habitat. Habitat quality will be lightly to moderately reduced in habitat outside of WUI in the short to mid-term, directly related to the level of tree removal. Where intermediate treatment methods are focused on groups of dead trees, regeneration of groups of live trees will promote brown creeper habitat in the long term. Habitat quality will be greatly reduced in the Forest's WUI areas because there are no Forest Plan requirements to retain snags or large recruitment trees in WUI areas. Snags and large trees are important components of brown creeper habitat. There are about 360,000 acres of potential treatment opportunities within these WUI areas.

Temporary roads will be obliterated and returned to the land base within 3 years under all intermediate and "other" treatment methods. Obliteration methods are described in design criteria in the draft EIS. Regeneration to suitable habitat will occur in similar time frames to regeneration within stand initiation treatment areas.

Forest Plan standards to retain 15% lodgepole, 25% ponderosa pine, and 25% spruce-fir old growth by mountain range will ensure that additional brown creeper habitat is also present on the landscape. These areas are most often larger than 100 acres, each providing habitat for several breeding pairs (Hutto 1995).

Noise associated with the machinery use, tools, and fire of treatment implementation can cause temporary disturbance to wildlife (see Forman et al.1997, Wisdom et al. 2005). Individuals could leave the immediate area during this brief period but could return after treatment is completed where habitat still exists. The temporary disturbances caused by these short-term activities are not expected to cause decreased reproductive success or survival across the population.

Impacts of the proposed actions to brown creepers by Accounting Unit (AU) can be estimated by several factors. For example, where the percentage of a species habitat in an AU is high or the acres in a No Treatment Area in habitat is high, then impacts to species habitat are less. Areas within lynx habitat cannot exceed treatment parameters and related exemptions and exceptions identified in the Southern Rockies lynx amendment, so impacts to brown creeper would parallel the resulting condition of overlapping Lynx Analysis Units (LAU). Where tree mortality is higher, vegetation management has little or no impact to habitat. On the other hand, where the percentage of an AU that is within WUI is high, the treatment impacts to habitat can be more pronounced because snags, large recruitment trees, and coarse woody debris do not have to be retained in treated areas. These habitat features are important to species that use old forest. Impacts of proposed actions are summarized in the table below.

Table 8. Impacts of Proposed Actions to Brown Creepers by Accounting Unit

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	High	High	Low	Low	Medium	Medium
Big Blackhall	Medium	Medium	Medium	Low	Medium	Medium
BowKettle	High	Low	Low	Low	Medium	Low
CedarBrush	High	Low	Low	Medium	Medium	Low
FoxWood	Low	Low	Low	Linkage Medium	Low	Low
FrenchDouglas	Medium	Medium	Low	Medium	Medium	Medium
GreenHog	Medium	High	Low	Low	Medium	Medium
JackSavery	High	Low	Low	Low	Low	Low
NorthCorner	High	Medium	Low	Medium	Medium	Medium
OwenSheep	Low	Low	Low	Na	Low	Low
PeltonPlatte	Low	High	Low	Linkage Medium	High	Medium
RockMorgan	High	High	Low	Medium	Medium	Medium
SandyBattle	Low	Low	Low	Na	Low	Low
WestFrench	High	Low	Low	Medium	Medium	Low

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005

interpretive memorandum regarding analysis of past actions, which states, “agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions.”

The pine beetle outbreak detailed earlier created a short-term dramatic improvement in habitat quality by creating trees and snags with loose bark and by providing an abundance of prey insects under the bark. Resulting snags would provide nesting habitat as long as sufficient density of live or dead canopy and limbs remained to prevent nest sites from being directly exposed to weather elements (see Wiggins (2005). These areas would still be suitable habitat where tree mortality is low to moderate. Habitat would no longer be suitable where tree mortality is high.

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Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce brown creeper habitat if they occur in stands with low or moderate tree mortality.

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Transportation System: Roads can have impacts to wildlife and habitat. Brown creepers have been found to avoid habitat within 100m of roads (Hutto 1995). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

Some habitat will remain across the Forest for brown creepers based on the following:

- This project impacts some habitat, reduces some habitat quality, and regenerates some areas not currently suitable habitat.
- Forest Plan guideline to consult Partners-in-Flight Conservation Plans (p. 1-40) for additional guidance was accomplished. Brown creeper is a Level II priority species.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Snowshoe Hare – MIS

Existing Condition

Life history information about snowshoe hares is available from USDA (2004b) and Miller (2004). The snowshoe hare occurs within an altitudinal range of approximately 2,440 to 3,350 meters (8000 to 10,990 ft) (Armstrong 1972). Habitats that provide forage and cover needs of snowshoe hare include stands of relatively taller vegetation with a dense, multi-layered understory that maximizes cover and browse at both ground level and at varying snow depths throughout the winter (stems and branches from one to three meters above the ground). These habitats include spruce/fir, lodgepole, and some aspen stands in the analysis area. In addition, snowshoe hares have been found to use willow riparian areas, especially during summer (Wolff 1980, Beauvais 1997, Ruediger et al. 2000). Relative to this project, proposed actions can impact spruce/fir, lodgepole, and aspen areas used by snowshoe hares. The snowshoe hare is a MIS for the Medicine Bow Plan addressing the issue of providing adequate prey for sensitive and threatened forest predators.

Potential snowshoe hare habitat across the Forest corresponds to lodgepole (3B, 3C, 4B, 4C), spruce-fir (3B-4C), and aspen forest (3B, 3C, 4B, 4C) with horizontal cover. Across the Forest, there are more than 300,000 acres of potential snowshoe hare habitat among lodgepole, spruce-fir, and aspen stands with dense horizontal cover (USDA 2003, p. 3-123). Much of this habitat has been impacted by the insect and disease outbreak.

Snowshoe hares exhibited mixed responses to pine beetle outbreaks among studies reviewed (Saab et al. 2014). Ivan and Seglund (2017) also evaluated mammal and bird response in Colorado to the bark beetle outbreak. There was no clear association between probability of use by snowshoe hares and levels of tree mortality or year since outbreak. Probability of use was lower in lodgepole stands than in spruce-fir stands at all levels of tree mortality and all years since the outbreak.

Anticipated effects of the lodgepole pine mortality from the pine beetle outbreak to snowshoe hares and their habitat in the long term are fully described in Dressen (2009). This analysis is included in the administrative record for this project. In brief for lodgepole pine stands, gradual summer use will occur in 10 years after the outbreak but regenerated trees will be too short for winter use even within 20 years. There will be a short following period in stands with high stem densities that will provide year-round habitat and hare density will increase. By 80 years after disturbance, stands will have reduced stem density from self-thinning, return to summer habitat only, and hare populations will decline to pre-disturbance levels. From 80 to 200 years, any remaining winter habitat will erode, summer habitat will continue to decline in quality through self-thinning, and hare abundance will return to typical, low density predisturbance levels.

By contrast, stands with a considerable spruce-fir mix will continue to create improved summer and winter habitat through 200 years. The beetle killed trees and subsequent stand growth and regeneration will add coarse woody debris, variable age classes of understory cover, and variety of forage plants to provide quality year-round habitat. These features will provide improved habitat for increased hare abundance.

Both peak and low densities of snowshoe hares have been shown to be lower in southern montane and sub-boreal forests than in northern boreal forests. In the southern regions of snowshoe hare range (which includes the Medicine Bow-Routt National Forest), peak densities are commonly 1-2 hares/ha, compared to northern populations with peak densities of up to 4-6 hares/ha (Hodges 2000). Snowshoe hares are found in most mountain ranges throughout Wyoming. Snowshoe hares are classified as a common resident, as a small game animal by the WGFD, and as occurring in 16 out of 28 mapped latilongs, (Cerovski et al 2004).

The snowshoe hare became a MIS with the Forest Plan revision completed in December 2003. Population trend data is available from pellet plots monitored across the Forest from 2004 through 2015. Since 2005 samples were stratified across habitat types on the Forest. Data collected to date are provided in the table below. The table suggests that snowshoe hares are found in relative abundance on the Medicine Bow and might mimic the cyclical nature of other snowshoe hare populations.

Table 9. Mean fecal pellets/sample plot of all lagomorphs across the Forest

Year	Mean
2006	4.09

2007	3.63
2008	3.64
2009	2.23
2010	3.18
2011	2.32
2012	1.89
2013	3.24
2014	3.15
2015	4.46

No Action Alternative

Direct and Indirect Effects

The pine beetle outbreak has had little impact to hare habitat in lodgepole pine stands so far. These stands at any age class provide lower quality habitat than spruce-fir. Habitat quality in lodgepole will improve over 20 years from regeneration for a brief period when stem density becomes high. When tree crowns grow above winter snow depths in several decades, cover and forage for hares will be reduced. These older stands will provide limited winter habitat in addition to summer habitat. Habitat quality in spruce-fir stands will be maintained or improve over time (Dressen 2009) due to the release of understory trees, retention of many live overrstory trees, and increase in coarse woody debris. Hares should remain sufficiently abundant to provide a supply of prey to the Forest's predators; which is the reason snowshoe hare was selected as a MIS for the Forest.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to lynx habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The pine beetle outbreak detailed earlier has so far had little impact to snowshoe hares (Saab et al. 2014, Ivan and Seglund 2017). Impacted areas are still considered suitable habitat. Habitat quality in spruce-fir will be retained or improved due to retention of live cover and accumulation of some woody debris.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce snowshoe hare habitat if they occur in stands with live and dead structure providing cover and forage.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat (Forman et al 1997, Joslin and Youmans 1999). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Modified Proposed Action

Direct and Indirect Effects

Habitat quality for snowshoe hares is dictated by dense horizontal cover. Lodgepole pine stands often have limited dense horizontal cover except for a brief period more than 20 years after regeneration. The insect and disease outbreak has had no clear impact to hare populations. Lodgepole pine typically does not provide the same habitat quality of mixed conifer or spruce-fir stands because dense horizontal cover is often limited in lodgepole, especially above the snow in winter.

Stand initiation treatments and associated temporary roads will occur in 95,000 acres due to moderate levels of insect and disease or reaching CMAI. The Forest's vegetation database suggests 4957 to 82,866 of the 95,000 acres of stand initiation treatment could be implemented because stands have reached CMAI. Field assessments in preparation for treatment will verify the final acreage of CMAI stands. Almost all Lodgepole stands where stand initiation will be implemented are considered suitable but low quality habitat. Stand initiation treatment and associated temporary roads will eliminate habitat in these stands. Regenerated areas will provide limited summer habitat in 10 years, followed by a short period of year-round habitat after 20 years. Since stand initiation will occur across so many acres over 15 years, there will be a short period of this increased year-round habitat. This will be followed by decades of lower quality habitat that occurs naturally during this period.

Secondly, regenerated habitat will be further reduced in quality in the Forest's WUI areas. There are no Forest Plan requirements to retain large recruitment trees or coarse woody debris in WUI areas. Logs and remnant large trees provide quality improvement features to lodgepole stands that are already lower quality habitat. There are about 360,000 acres of potential treatment opportunities within these WUI areas, so this quality reduction will be extensive.

Intermediate and "other" treatments and associated temporary roads will reduce habitat quality. These stands have lower levels of tree mortality and are often the spruce-fir stands that provide the highest quality habitat. Habitat quality will be lightly to moderately reduced in habitat outside of WUI in the short to mid-term, directly related to the level of tree removal. Where intermediate treatment methods are focused on groups of dead trees, regeneration of groups of live trees will promote the dense horizontal cover of snowshoe hare habitat in the long term. Habitat quality will be greatly reduced in the Forest's WUI areas because there are no Forest Plan requirements to retain coarse woody debris or large recruitment trees in WUI areas. Coarse woody debris and large trees are important components

of snowshoe hare habitat. There are about 360,000 acres of potential treatment opportunities within these WUI areas, so the quality reduction will be extensive.

Temporary roads will be obliterated and returned to the land base within 3 years under all intermediate and "other" treatment methods. Obliteration methods are described in design criteria in the draft EIS. Regeneration to suitable habitat will occur in similar time frames to regeneration within stand initiation treatment areas.

Forest Plan standards to retain 15% lodgepole, 25% ponderosa pine, and 25% spruce-fir old growth by mountain range will ensure that additional snowshoe hare habitat is present on the landscape. These areas are most often larger than 100 acres, each providing habitat for several numerous breeding individuals (Hodges 2000).

Noise associated with the machinery use, tools, and fire of treatment implementation can cause temporary disturbance to wildlife (see Forman et al.1997, Wisdom et al. 2005). Individuals could leave the immediate area during this brief period but could return after treatment is completed where habitat still exists. The temporary disturbances caused by these short-term activities are not expected to cause decreased reproductive success or survival across the population.

Impacts of the proposed actions to snowshoe hares by Accounting Unit (AU) can be estimated by several factors. For example, where the percentage of a species habitat in an AU is high or the acres in a No Treatment Area in habitat is high, then impacts to species habitat are less. Areas within lynx habitat cannot exceed treatment parameters and related exemptions and exceptions identified in the Southern Rockies lynx amendment, so impacts to snowshoe hares would parallel the resulting condition of overlapping Lynx Analysis Units (LAU). On the other hand, where the percentage of an AU that is within WUI is high, the treatment impacts to habitat can be more pronounced because snags, large recruitment trees, and coarse woody debris do not have to be retained in treated areas. These habitat features are important to species that use dense forest cover. Impacts of proposed actions are summarized in the table below. Hares should remain available in suitable habitat to provide a supply of prey to the Forest's predators; which is the reason snowshoe hare was selected as a MIS for the Forest.

Table 10. Impact of Proposed Actions to Snowshoe Hares by Accounting Unit

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat
BattlePass	High	Medium	Low	Medium	Medium
Big Blackhall	Medium	Medium	Low	Medium	Medium
BowKettle	High	Low	Low	Medium	Low
CedarBrush	High	Low	Medium	Medium	Low

FoxWood	Medium	Low	Linkage Medium	Low	Low
FrenchDouglas	Medium	Medium	Medium	Medium	Medium
GreenHog	Medium	Medium	Low	Medium	Low
JackSavery	High	Low	Low	Low	Low
NorthCorner	High	Medium	Medium	Medium	Medium
OwenSheep	Medium	Low	na	Low	Low
PeltonPlatte	Medium	High	Linkage Medium	High	Medium
RockMorgan	High	Medium	Medium	Medium	Medium
SandyBattle	Medium	Low	na	Low	Low
WestFrench	High	Low	Medium	Medium	Low

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The pine beetle outbreak detailed earlier has so far had little impact to snowshoe hares (Saab et al. 2014, Ivan and Seglund 2017). Impacted areas are still considered suitable habitat. Habitat quality in spruce-fir will be retained or improved due to retention of live cover and accumulation of some woody debris.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These

treatments could reduce snowshoe hare habitat if they occur in stands with live and dead structure providing cover and forage.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat (Forman et al 1997, Joslin and Youmans 1999). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

Some habitat will remain across the Forest for snowshoe hares based on the following:

- This project impacts some habitat, reduces some habitat quality, and regenerates many areas in lodgepole pine to yearround habitat for a short period in about 20 years.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Three-toed Woodpecker – MIS

Existing Condition

Life history information is available in Anderson (2003) and Wiggins (2004). The three-toed woodpecker is primarily associated with high-elevation (above 8,900 feet), old-growth conifer forests, specifically spruce-fir and lodgepole habitats (Wiggins 2004, Cerovski 2004, Nicholoff 2003). This association is especially linked to a dependence on mature, un-logged, and naturally disturbed forest stands (Wiggins 2004). The species shows a preference for spruce-fir forests (Bock and Bock 1974, Hoyt and Hannon 2002), although lodgepole forests are used extensively after disturbance (Wiggins 2004, Cerovski 2004, Nicholoff 2003). A limited number of records demonstrate utilization of ponderosa pine and aspen stands (Wiggins 2004, citing Versaw 1998). The species' flexibility in habitat use is predominately determined by their dependence on infestations of bark beetles and wood-boring beetles. The distribution of three-toed woodpecker is often patchy and variably irruptive, based on the distribution and abundance of beetle species on which they forage (Wiggins 2004, Nicholoff 2003, Imbeau 2002). The association of the species with disturbed, mature forests is a function of its reliance on bark and wood-boring beetles. Optimal habitat has been described as having approximately 50 snags per 100 acres. A minimum of one snag per 2 to 3 hectares is required (Nicholoff 2003). Aggregations of three-toed woodpeckers are typically exaggerated in the winter, as the species generally does not migrate away from breeding grounds, but rather congregates in areas with abundant food resources (Wiggins 2004).

Although not abundant at background population levels, these woodpeckers thrive when fires, insects or diseases ravage a forest (Kingery 1998). Three-toeds forage primarily on larval and adult forms of bark (scolytid) beetles and to a lesser extent on wood-boring beetles (Cerambycidae and Buprestidae), so they are very much dependent on abundant trees infested with these cambium-dwelling insects (Koplin 1969, DeGraff *et al.* 1991, Murphy and Lehnhausen 1998, Wiggins 2004). Dead and heartrot-infested trees also supply roosting habitat and a place to drill a nest cavity. Therefore, any forest disturbance, resulting in bark beetle colonization of numerous trees, provides the ideal situation for three-toed woodpeckers to prosper. Likewise, because of the close tie between these birds and beetle-infested trees, the population of three-toed woodpeckers oscillates considerably with the rise and fall of bark beetles numbers and in synchrony with the incidence of disturbance events (Kingery 1998). Once the bark beetle population diminishes in an area, three-toed woodpeckers leave to locate a new source of food (Kingery 1998). In the absence of large-scale disturbance, older spruce/fir forests provide a refuge for endemic populations of the three-toed woodpecker.

From USDA (2003) concerns include: *Reduction in amount of post-fire habitat has removed prime habitat. Removal of snags (in harvested areas) has reduced potential nest sites. The amount of old forest is believed to be within the range typical of the past; but patch size and interior forest have been reduced. At a broad scale, two habitat types that are becoming rare in boreal forest are post-burn early-successional stands and old growth (Schmiegelow and Monkkonen 2002), the two types used by this species. Old forests have declined in area on the Medicine Bow (Welp et al. 2000). Though the current area may not be outside of the historic range of variation (HRV), it is at the low end; maintaining old*

growth at the low end of the range over long periods would be out of HRV in terms of long-term patterns (USDA 2003, citing Dillon and Knight et al. 2003; and Finch and Stangel 1992).

The primary concerns for three-toed woodpeckers are habitat changes due to logging, especially salvage logging (USDA 2003, p. I-173, Anderson 2003, Wiggins 2004) and fire suppression (Anderson 2003, Wiggins 2004). The three-toed woodpecker is a MIS for the Medicine Bow Plan addressing snags, old forest, and recently burned forest.

Potential three-toed woodpecker habitat across the Forest corresponds to spruce-fir and lodgepole pine forest of structural stages 4A through 4C. As noted earlier in this report, >500,000 acres were affected by insects and disease, temporarily increasing woodpecker habitat. This outbreak created exceptional woodpecker habitat in stands while beetles were infesting those stands. However, utility of this habitat has declined dramatically as the beetle outbreak subsided. Stands where the vast majority of trees have died do not provide suitable habitat currently. There are currently more than 255,000 acres of habitat in the LAVA project area. Due to its low abundance and transient nature, the species has a vast resource and habitat base to support the population on the Forest. Maintenance of live late-seral spruce-fir will provide a large number of areas containing high-quality breeding and foraging habitat.

This uncommon, inconspicuous woodpecker usually exists at very low densities. The species exists on the Forest, as it does over the rest of its range, with a broad distribution and low abundance. Concentrations of the species are irruptive and transient, based upon its preference for recent disturbances. Its distribution and abundance are dictated by available habitat and disturbances to it. The three-toed woodpecker is a yearlong resident, known to breed on the Medicine Bow National Forest.

Monitoring data collected to date is provided in the table below. They are sufficiently uncommon that they have not been detected on any of the BBS routes on or adjacent to the Forest since the 1st route was surveyed in 1968. Therefore, survey design within the RMBO songbird protocol was specifically adjusted in 2003 to account for birds such as the three-toed woodpecker. Results from 2003 and 2004 are a combination of RMBO survey protocol transects and opportunistic observations. After 2004, survey transects were standardized for monitoring across the Forest. Results strongly suggest that the three-toed woodpecker population trend has varied in response to the level of the insect and disease outbreak. Population trend results are available on the RMBO website:

http://rmbo.org/v3/avian/ExploretheData.aspx

Table 11. Annual Three-toed Woodpecker Monitoring Results across the Forest.

Year	# Observed
2001	1
2002	1

2003	21
2004	39
2005	15
2006	41
2007	52
2008	47
2009	20
2010	32
2011	49
2012	7
2013	14
2014	6
2015	3

No Action Alternative

Direct and Indirect Effects

The pine beetle outbreak created a short-term (+/- 10 yrs.) dramatic improvement in habitat quality by creating trees and snags with an abundance of insect prey and potential cavity nesting sites. However, these stands have decreased in value and now provide prey habitat conditions similar to conditions existing before the outbreak occurred. There are still abundant snags and deteriorated trees available for cavity nests. Three-toed woodpecker abundance has declined in response to decreased prey. These conditions will exist until the next disturbance event. Forest regeneration could produce more, lower quality mature, live lodgepole habitat again in 80-100 years.

Stands with lower amounts of tree mortality and spruce-fir stands will be retained or improved as suitable habitat, compared to habitat that existed before the outbreak. Dillon et al. (2003) indicated that snags and coarse woody debris are probably lower than HRV on the Forest due to past management. Dillon et al. (2003) stated that periodic episodes of severe insect damage most likely will always be a part of Rocky Mountain forest dynamics and mortality caused by insects has probably been the second most important form of disturbance in high-elevation forests. Additional snags in these stands has likely improved three-toed woodpecker habitat for several decades as a result. For example, Johnson (*in* Saab et al. 2014) noticed that bark-drilling woodpeckers, such as three-toed woodpeckers, nested almost exclusively in aspen trees before the outbreak on this Forest. When conifer snags became abundant after the outbreak, nest placement by these birds shifted to conifers.

Understory productivity will increase, advanced regeneration growth rate will increase, and subalpine fir trees will become a larger component of these stands (Dhar et al. 2016, Malcolm 2012). The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to lynx habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The pine beetle outbreak detailed earlier created a short-term dramatic improvement in habitat quality by creating trees and snags with an abundance of prey insects and potential cavity nesting sites. However, many of these stands have decreased in value and now provide prey habitat conditions similar to conditions existing before the outbreak occurred. Stands with low to moderate tree mortality will be maintained or improved as habitat

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce woodpecker habitat if they occur in stands with low or moderate tree mortality.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat (Forman et al 1997, Joslin and Youmans 1999). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Modified Proposed Action

Direct and Indirect Effects

Wiggins (2004) observed, “habitat loss and degradation appear to be the primary threats [p. 29]” to persistence of three-toed woodpeckers, largely as a result of fire and insect suppression activities that disrupt or truncate natural disturbances. Trees infested with bark beetles, and numerous dead trees in various stages of heartwood decay, are the primary habitat requisites for sustaining these woodpeckers (Murphy and Lehnhausen, Wiggins 2004). Most trees are no longer infested with bark beetles.

Stand initiation management and associated temporary roads will have little impact where tree mortality is high. These stands are not suitable habitat. Tree mortality created many snags for potential cavity nests but insect prey has declined substantially as displayed in the Forest’s bird monitoring results above. Regeneration will promote future foraging habitat in several decades and nesting habitat in 80-100 years. Forest Plan Standards to retain live recruitment trees and snags will provide some individual foraging sites while regenerated stands mature.

The Forest's vegetation database suggests 4957 to 82,866 of the 95,000 acres of stand initiation treatment could be implemented because stands have reached CMAI. Field assessments in preparation for treatment will verify the final acreage of CMAI stands. These stands are considered suitable habitat because they contain live trees and some snags from the insect/disease outbreak. Stand initiation treatment and associated temporary roads will eliminate habitat in stands with lower insect/disease levels or that have reached CMAI. Regenerated areas will provide foraging habitat in several decades when mature trees again provide habitat for insect prey. Forest Plan Standards to retain recruitment trees and snags will provide some individual foraging sites while regenerated stands mature. Nesting habitat will be produced in 80-100 years as large snags are created again. The decline in habitat will be directly related to the proportion of regeneration treatments in higher mortality insect/disease stands versus CMAI stands.

Secondly, regeneration of foraging and nesting habitat will be delayed for stands that occur in the Forest's WUI areas. There are no Forest Plan requirements to retain snags or large, live recruitment trees in WUI areas. Snags and large trees are important components of three-toed woodpecker habitat, providing individual foraging sites within regenerated stands and providing habitat characteristics in future mature stands. There are about 360,000 acres of potential treatment opportunities within these WUI areas. So, a substantial amount of three-toed woodpecker habitat will have delayed development and lower habitat quality.

Intermediate and "other" treatments and associated temporary roads will reduce habitat quality. These stands have lower levels of tree mortality and are often the mixed conifer or spruce-fir stands that provide the best habitat (Bock and Bock 1974 and Hoyt and Hannon 2002). Habitat quality will be lightly to moderately reduced in habitat outside of WUI areas in the short to mid-term, directly related to the level of tree and snag removal. Where intermediate treatment methods are focused on small groups of dead trees, regeneration of groups of live trees will promote three-toed woodpecker habitat in the long term. Habitat quality will be greatly reduced in the Forest's WUI areas because there are no Forest Plan requirements to retain snags or large recruitment trees in WUI areas. Snags and large trees are important components of three-toed woodpecker habitat, providing individual foraging sites within regenerated stands and providing habitat characteristics in future mature stands. There are about 360,000 acres of potential treatment opportunities within these WUI areas. So, a substantial amount of three-toed woodpecker habitat will have lower habitat quality and need years to decades to provide snags as habitat components.

Vegetation management where prescribed fire is the implementation tool could cause improvements to woodpecker habitat. Burned stands will attract prey insects and will maintain snags for cavity use compared to mechanical treatment methods. This type of disturbance can especially improve habitat conditions in lodgepole pine stands (Wiggins 2004).

Temporary roads will be obliterated and returned to the land base within 3 years under all intermediate and "other" treatment methods. Obliteration methods are described in design criteria in the draft EIS. Regeneration to suitable habitat will occur in similar time frames to regeneration within stand initiation treatment areas.

Forest Plan standards to retain 15% lodgepole, 25% ponderosa pine, and 25% spruce-fir old growth by mountain range will ensure that additional three-toed woodpecker habitat is also present on the landscape. These areas are most often larger than 100 hectares, each providing habitat for a breeding pair at endemic prey levels (Raphael 1987).

Noise associated with the machinery use, tools, and fire of treatment implementation can cause temporary disturbance to wildlife (see Forman et al.1997, Wisdom et al. 2005). Individuals could leave the immediate area during this brief period but could return after treatment is completed where habitat still exists. The temporary disturbances caused by these short-term activities are not expected to cause decreased reproductive success or survival across the population.

Impacts of the proposed actions to three-toed woodpeckers by Accounting Unit (AU) can be estimated by several factors. For example, where the percentage of a species habitat in an AU is high or the acres in a No Treatment Area in habitat is high, then impacts to species habitat are less. Areas within lynx habitat cannot exceed treatment parameters and related exemptions and exceptions identified in the Southern Rockies lynx amendment, so impacts to three-toed woodpecker would parallel the resulting condition of overlapping Lynx Analysis Units (LAU). Where tree mortality is higher, vegetation management has little or no impact to habitat. On the other hand, where the percentage of an AU that is within WUI is high, the treatment impacts to habitat can be more pronounced because snags, large recruitment trees, and coarse woody debris do not have to be retained in treated areas. These habitat features are important to species that use old forest. Impacts of proposed actions are summarized in the table below. Three-toed woodpeckers will remain in suitable habitat in direct relation to the amount of snags, old forest, and recently burned forest retained or created. These are the characteristics for which three-toed woodpecker was selected as a MIS.

Table 12. Impacts of Proposed Actions to Three-toed Woodpeckers by Accounting Unit.

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	High	Medium	Low	Low	Medium	Medium
Big Blackhall	Medium	Medium	Medium	Low	Medium	Medium
BowKettle	High	Low	Low	Low	Medium	Low
CedarBrush	High	Low	Low	Medium	Medium	Medium
FoxWood	Medium	Low	Low	Linkage Medium	Low	Low
FrenchDouglas	High	Medium	Low	Medium	Medium	Medium

GreenHog	High	Medium	Low	Low	Medium	Medium
JackSavery	High	Low	Low	Low	Low	Low
NorthCorner	High	Medium	Low	Medium	Medium	Medium
OwenSheep	Medium	Low	Low	Na	Low	Low
PeltonPlatte	Low	High	Low	Linkage Medium	High	Medium
RockMorgan	High	High	Low	Medium	Medium	Medium
SandyBattle	Low	Medium	Low	Na	Low	Low
WestFrench	Medium	Low	Low	Medium	Medium	Low

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The pine beetle outbreak detailed earlier created a short-term dramatic improvement in habitat quality by creating trees and snags with an abundance of prey insects and potential cavity nesting sites. However, many of these stands have decreased in value and now provide prey habitat conditions similar to conditions existing before the outbreak occurred. Stands with low to moderate tree mortality will be maintained or improved as habitat

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce woodpecker habitat if they occur in stands with low or moderate tree mortality.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

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Transportation System: Roads can have impacts to wildlife and habitat (Forman et al 1997, Joslin and Youmans 1999). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

Some habitat will remain across the Forest for three-toed woodpeckers based on the following:

- This project impacts some habitat, reduces some habitat quality, regenerates some areas, and has the potential to improve some habitat in the short-term where prescribed burning is used to treat lodgepole pine stands.
- Forest Plan guideline to consult Partners-in-Flight Conservation Plans (p. 1-40) for additional guidance was accomplished. Three-toed woodpecker is a Level II priority species.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Golden-Crowned Kinglet – MIS

Existing Condition

Life history information is available from Nicholoff (2003), USDA (2004), and Galati (1991). Golden-crowned kinglets (*Regulus satrapa*) are associated with high elevation coniferous forests, preferring to nest and forage within the interiors of dense, mature, old-growth stands. They are typically found in spruce-fir habitats having heavy canopy cover, often near streams. They can also be found, usually somewhat less abundantly, in mature lodgepole stands and mixed deciduous-conifer stands, especially those with a mature aspen component (Nicholoff 2003, USDA 1981). Golden-crowned kinglets are most prominently associated with spruce species, a connection that dominates the species' distribution (Nicholoff 2003, Galati 1991). Their usage of mixed stands is most common during migration and wintering at lower elevations than is typical during the breeding season (USDA 1981).

They are gleaning specialists, foraging mostly on insects and insect eggs (Nicholoff 2003, Galati 1991, USDA 1981). Foraging occurs in spruce, fir, and pine trees (Galati 1991) with birds gleaning insects from foliage, twigs, limbs, and bark of the trees (USDA 1981). Wintering birds forage opportunistically, but appear to subsist mainly on lepidopterous caterpillars in the canopy (Heinrich and Bell 1995).

Golden-crowned kinglets are sensitive to forest cutting and are less common in forests and stands that have been cut, partially cut, thinned (Nicholoff 2003) or in habitats with naturally open canopies (USDA 2004). The species is also sensitive to prescribed and wild fires, especially those reducing the canopy-cover (USDA 2004). Kinglets are the smallest passerine bird, with high energetic demands. Availability of roost sites such as tree cavities or squirrel nests are critical in winter. The golden-crowned kinglet is a MIS for the Medicine Bow Plan addressing the uneven aged management in spruce-fir/within stand fragmentation issue, the condition and adequacy of canopy cover in spruce-fir stands including partial harvest effects. This will be referred to simply as canopy cover in spruce-fir stands. Relative to this project, beetle caused changes to habitat are not likely to be additive to effects of the project.

Across the Forest, there are >200,000 acres of suitable habitat, spruce-fir classes 4A, 4B, and 4C and lodgepole classes 4B and 4C (USDA 2003, p. 3-123). Other lodgepole pine stands are no longer suitable due to the loss of dense canopy as a result of the pine beetle outbreak. The analysis of habitat changes for the 2003 Forest Plan revision indicated that mature lodgepole habitat changed less than 5% between 1985 and 2003 and indicated that mature spruce-fir decreased by less than 1% during the same period. In selecting the golden-crowned kinglet as an MIS for the 2003 Revision of the Forest Plan (USDA 2003), no concern existed for species viability or viability of local populations, and "viability" was neither a rationale nor motivation for its inclusion on the Forest MIS list.

Several sources of information are available and useful for estimation current population status, trend, and abundance for golden-crowned kinglets on the Medicine Bow National Forest. These data reflect different landscape scales and include results that have been gathered over large geographic areas (i.e., the southern Rocky Mountains) as well as locally (within the Coon Creek Analysis Area and Little Snake River drainage). While none of these data are independently adequate to estimate golden-crowned kinglet population trend and abundance, and some information may even be contradictory, collectively the

information affords a basis for making credible inferences about population trend and abundance for this species on the Forest.

The golden-crowned kinglet is classified as demonstrably secure, globally, by Natural Heritage Programs (NatureServe 2005). The species is found across most of North America, bounded by the distribution of spruce species. The global population is estimated at about 10 million individuals, with the greatest densities found near in coastal Pacific States. It is one of the most abundant species found in Oregon and Washington. However, it is much less abundant in Wyoming and Colorado. Statistically significant population declines of about 3% per year have been documented recently in California, Oregon, and Washington, crucial states to the population's viability. Despite the declines in the species' stronghold, significant increases of approximately 6% per year have been recorded in the eastern United States, likely due to spruce-fir reforestation (USDA 2004).

The golden-crowned kinglet is a resident of Wyoming and is considered to be uncommon (Cerovski 2004). It is classified as a Level II priority species by Wyoming Partners in Flight. A potentially declining population trend and loss of habitat are not considered critical at this time and Wyoming Partners in Flight considers the state-wide trend of the species uncertain (Nicholoff 2003). The species is classified as secure nationally, but the Wyoming Natural Heritage Program ranks the golden-crowned kinglet as vulnerable to extirpation within the state (NatureServe 2005).

Past heavy utilization of spruce-fir forests led to dramatic declines in kinglet abundance, but the species has been recovering well as a result of habitat improvements with some remaining vulnerability in Wyoming and the Region (Patton 2001).

Table 13. Monitoring of golden-crowned kinglets on the Medicine Bow National Forest.

YEAR	# Observed	Total Survey Points
2008	7	281
2009	15	165
2010	8	268
2011	2	306
2012	8	344
2013	0	353
2014	0	331
2015	7	282
2016	1	189

Evidence of the species' broad distribution and low abundance on the Forest was gathered locally with a preliminary study conducted in the Coon Creek Timber Sale before treatment to determine avian species

abundance in various habitats. Successive monitoring was not performed, but a great deal of local information was collected. Raphael (1987) reported mean densities of species in the Coon Creek and East Fork watersheds. Golden-crowned kinglets were found at a density of 29 birds/100 hectares in pole size lodgepole habitat, increasing to 33 birds/100 hectares of sawtimber size lodgepole. The greatest density reported for sawtimber size spruce-fir was 69 birds/100 hectares. The data indicated that golden-crowned kinglets are found at densities near 7 acres/pair within high-quality habitat on the Forest, consistent with the broad distribution and low abundance observed over much of the species' range.

The NRIS Wildlife database contains 49 records of golden-crowned kinglet observations across all units of the Medicine Bow National Forest between 2004 and 2016. These account for 163 individual kinglets observed. During field work in 2017 I observed by sound and/or saw 12 golden-crowned kinglets or groups of kinglets in the SR alone. However, 2017 may have been a year of higher abundance or increased success for the species, leading to more detections than normal.

Jenniges (1991) assessed habitat utilization of wildlife on the Forest in a study within the Little Snake River drainage. Avian monitoring located several golden-crowned kinglets at various locations on Deadman Creek, Harrison Creek, and Third Creek. Two seasons of observation (1989, 1990) resulted in the observation of 19 and 7 golden-crowned kinglets, respectively.

Habitat relations were the focus of the study and no trend was available from it. Keller and Anderson (1992) conducted population monitoring of Forest species to analyze impacts created by fragmentation as a result of small-scale clearcutting. They found minimal impact to golden-crowned kinglet abundance with an average density of less than 1 kinglet per 10 hectares in both fragmented and unfragmented stands.

Across the Forest there has been substantial decrease in the mature lodgepole habitat type, but there has been little change in the core spruce-fir nesting habitat. The pine beetle outbreak reduced some habitat across >600,000 acres on the Forest. Impacts to kinglets might be reflected in the low number of observations since 2009. This kinglet population was expected to decline somewhat over the next few years due to some declines in live mature lodgepole. However, most kinglet habitat occurs in spruce-fir which is not being impacted by the mountain pine beetle outbreak. Continued annual monitoring of kinglet trend and of these habitats will help to determine impacts upon the species.

No Action Alternative

Direct and Indirect Effects

The insect and disease outbreak has affected mainly lodgepole pine, and to a much lesser degree spruce/fir forest types. For golden-crowned kinglets, a species with preferences leaning toward spruce/fir forest types, current conditions are relatively favorable. Over time, conditions will improve slightly as lodgepole pine stands regenerate, adding habitat for the species. Core habitat (spruce/fir) types will remain intact, and may improve in quality or maintain quality.

The main natural factor influencing wildlife habitat is the insect/disease outbreak. Under the no action alternative, there are few impacts to wildlife, as no human-influenced vegetation management activity

would occur. Lodgepole stands with high mortality most often exist as unsuitable habitat for several decades. Canopy cover and conifer tree seed production have declined substantially in the short term.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to wildlife habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce habitat if they occur in stands with low or moderate tree mortality.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Kinglets are detected near roads approximately as often as they are away from roads (Hutto etal. 1995). Still, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Modified Proposed Action

Direct and Indirect Effects

LaVA potential effects to species will vary from one analysis unit (AU) to the next dependent on a variety of factors (i.e. how much of the AU is in wilderness or other excluded area, how much has been treated in previous projects, etc). In table 14 and 15 below is an analysis of current golden-crowned kinglet habitat estimates within the two mountain ranges included in analysis.

Table 14. Habitat and treatment opportunity acres in analysis units in the Sierra Madre Range.

Analysis Unit	Total Acres	Acres available for SISS
Big Blackhall	73,222	19,895
Green Hog	65,940	12,347
Battle Pass	49,436	13,639
Sandy Battle	94,484	27,044
Jack Savery	79,138	29,734

Total Estimated Habitat in Mountain Range	Estimated Acres Current Habitat	Acres available for intermediate treatment	Acres green tree treatment
41,694	4,088	31,460	30,733
	1,737	32,765	13,820
	17,157	15,371	12,614
	13,388	15,454	12,139
	5,594	15,674	14,321

Table 15. Habitat and treatment opportunity acres in analysis units in the Snowy Range.

Analysis Unit	Total Acres
Pelton Platte	49,297
Fox Wood	85,609
Owen Sheep	28,798
French Douglas	66,086
West French	69,697
North Corner	45,106
Rock Morgan	62,487
Cedar Brush	60,899
Bow Kettle	64,493

Total Estimated Habitat in Mountain Range	Estimated Acres Current Habitat	Acres intermediate treatment	Acres available green tree	Acres Available for SISS
90,645	904	4,242	6,439	5,802
	1,705	18,342	34,077	35,130
	49	4,186	6,138	28,798
	4,280	11,080	23,941	17,322
	13,811	14,790	25,576	18,296
	14,355	15,095	10,550	15,723
	15,875	16,580	19,459	14,059
	20,904	14,327	22,852	10,725
	18,762	14,471	23,692	14,026

Table 16. Potential golden-crowned kinglet habitat quality per AU after treatment.

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	High	Medium	Low	Low	High	Medium

Big Blackhall	Low	Medium	Medium	Low	High	Medium
BowKettle	Medium	Low	Low	Low	High	Medium
CedarBrush	High	Low	Low	Medium	High	Medium
FoxWood	Low	Low	Low	Linkage Medium	Low	Low
FrenchDouglas	Low	Medium	Low	Medium	Low	Low
GreenHog	Medium	Medium	Low	Low	High	Medium
JackSavery	Low	Low	Low	Low	High	Low
NorthCorner	High	Medium	Low	Medium	Medium	Medium
OwenSheep	Low	Low	Low	Na	Low	Low
PeltonPlatte	Low	High	Low	Linkage Medium	Medium	Medium
RockMorgan	Medium	High	Low	Medium	Medium	Medium
SandyBattle	Low	Medium	Low	Na	High	Medium
WestFrench	Medium	Low	Low	Medium	High	Medium

Stand initiation treatments (SISS)

The LaVA project proposes stand-initiating treatments be applied to up to 95,000 acres over the life of the project. The intention is to primarily treat stands which have been killed during the MPB epidemic.

The option is available to apply stand-initiating treatments to live stands that have reached 95% or higher CMAI. Highest estimates of these potential treatments indicate between 4,957 acres and 82,866 acres are available for these treatments.

For the purpose of this analysis, I will assume "worst-case" scenario for the golden-crowned kinglet. This highly unlikely scenario implies that stand-initiating treatments will be applied to 82,866 acres of green trees, leaving less than 13,000 acres of this type of treatment in dead, dying, and diseased stands.

After 95,000 acres are treated between the Snowy Range and Sierra Madre Range, assuming 82,866 acres were mature green spruce/fir stands, approximately 49,473 out of the current 132,339 acres (see tables 14 and 15 above) will continue to be available to kinglets. These acres will be distributed between the SM and SR.

This constitutes a drastic decline in habitat. While this species may continue using stands with dead trees or smaller trees, they will likely experience a reduction in success doing so.

Also, with timber harvest comes noisy machinery. The species may avoid the area of treatment during operations or desert the nest.

Smoke from prescribed burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could potentially cause failure of an active nest or individuals to avoid the area temporarily.

Intermediate/Uneven-aged Treatments

LaVA proposes up to 165,000 acres in intermediate treatments. These treatments would not revert stands to a re-initiation stage. They may, however, remove the large trees from a stand to open up the understory to growth, or remove clumps of trees, creating an uneven aged stand, or a variety of other options.

Intermediate treatments may be detrimental to the species. For example, overstory removal would remove large trees and the plentiful insect forage that comes with them.

Intermediate treatments, as with stand-initiation treatments, are planned to take place primarily in areas of heavy beetle kill. While goshawks may use these areas, and nests have produced offspring, it is unknown how successful their nesting attempts are in these areas or how long dead stands will continue to be used.

Noise from machinery and vehicles has the possibility of affecting kinglets with this treatment type as well. The species may avoid the area temporarily or desert the nest.

Smoke from prescribed burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could potentially cause an active nest to fail or individuals to avoid the area temporarily.

Other Treatments

LaVA proposes up to 100,000 acres of ‘other’ treatment types. This could be shrub removal, conifer encroachment, jackpot burning, or various other treatments related to the understory. It is possible that shrub removal/fuels reduction or other projects may occur within or near kinglet habitat. Also included in this treatment category is coppice cuts, which will lead to regeneration of aspen stands through clear-cut treatments of aspen.

Potential direct effects to kinglets through understory treatments are possible. While kinglets typically feed by gleaning insects from the crowns of spruce-fir and other conifers, removal of a dense brush understory may lead to a reduction in prey insect species.

Smoke from brush burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could cause an active nest to fail or individuals to avoid the area temporarily.

Noise from machinery and vehicles brings with it the possibility of affecting kinglets in these treatment types as well. Individuals may avoid the area temporarily or desert the nest.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The pine beetle outbreak detailed earlier has so far had little impact to golden-crowned kinglets or their preferred habitat.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could remove a small amount of habitat if they occur in stands with low or moderate tree mortality.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Roads were not shown to have an impact on golden-crowned kinglet detectability (Hutto 1995). Still, it is possible the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

Some habitat will remain across the Forest for golden-crowned kinglets based on the following:

- This project impacts some habitat, reduces some habitat quality, regenerates some areas, and has the potential to improve some habitat in the long-term where dead lodgepole pine stands are regenerated.
- Forest Plan guideline to consult Partners-in-Flight Conservation Plans (p. 1-40) for additional guidance was accomplished. Golden-crowned kinglet is a Level II priority species.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to American Marten – MIS / Sensitive Species

Existing Conditions

From USDA 2003, App. I: *Martens are primarily animals of dense, old forest with a complex structure of understory and downed wood. Late-successional multi-storied stands of spruce-fir forest are preferred, though multistoried lodgepole (usually with invading subalpine fir) and other forest types with downed wood are also used. Martens are found in dense forest with canopy cover of at least 30%. A complex arrangement of downed wood (large logs, tangles of smaller material, root wads, downed trees with branches, and sloping logs and branches) provides habitat for prey, cover from predators, dens, resting sites, and entry to subnivian habitat. Squirrel middens, hollow logs, cavities in snags, and rock piles are used for dens. Partially arboreal, marten hunt and rest in trees, in cavities and on mistletoe brooms. Marten depend on old forest components like large snags and downed wood for maternal and natal dens. Though summer rest sites vary greatly, during winter, martens rest in large downed wood insulated by snow cover. The home range can have inclusions of mature forest and some openings as long as the old-forest features are abundant and well distributed.*

Martens might also be affected by fragmentation (or perforation) in addition to habitat loss. Martens strongly avoided patch cuts (approximately 1 to 5 acres in size) in the Coon Creek study area on the Forest (USDA 2003). The few tracks detected in the cuts occurred only in the 1st or 2nd year following logging and hugged the edge. Potvin et al. (2000) found that martens were fairly intolerant of "habitat fragmentation" and cannot tolerate more than 30-35% cutovers in its home range. The authors stated that where the objective is to maintain marten habitat at a local scale, $\geq$ 50% uncut forest be preserved

inside 10 km^2 (2471 acre) units and that < 30% of the area be clearcut over a 30-year period. Similarly, Chapin et al. (1998) found that martens tolerated a median of only 20% regenerating clearcuts in their home ranges. Bissonette et al. (1997) indicated that martens appear to avoid landscapes with more than 25% to 30% of the total area in vegetation types other than intact older forests. Finally, Hargis et al. (1999) reported that martens were absent from landscapes ($\geq$9 km^2) having >25% nonforested cover. Further, they found that forested landscapes appeared unsuitable for martens when the average distance between open patches was <100m. This proximity of open areas in their study eliminated nearly all forest interior relative to martens.

However, recent review (Fahrig 2003) suggests that past research actually evaluated only habitat loss and not the larger landscape-scale process involving both habitat loss and the breaking apart of habitat known as fragmentation. Fahrig (2003) stated that researchers did not measure the breaking apart of habitat, fragmentation, after controlling for habitat loss. Hargis et al. (1999) was one of the research projects evaluated in Fahrig (2003).

Furthermore, Potvin, Chapin, and Hargis, above, made evaluations at the scale of a marten home range. Mean home ranges for American martens in the Encampment River watershed of the Forest were found to be 1652 acres in summer and 1462 acres in winter for females and 4494 acres in summer and 3602 acres in winter for males (O'Doherty et al. 1997). Even Bissonette et al. (1997) related "fragmentation" to % loss of habitat at a landscape scale but did not evaluate landscape pattern while controlling for habitat loss. While all these researchers did find strong results related to habitat loss, they did not independently evaluate landscape scale fragmentation as pointed out by Fahrig (2003). Finally, Fahrig (2003) also concluded that the effects of habitat loss were much greater than the effects of fragmentation.

Regardless of this debate among researchers on whether fragmentation is truly being measured as an independent effect in wildlife research studies, the Forest has experienced some habitat changes as a result of Forest management actions in the last 5 decades. Some type of timber harvest, and a supporting road network, has occurred over approximately 132,937 acres (12.3%, USDA 2003 p. 3-150) of the forested habitat across the Forest over 50 years. From this standpoint, it appears there has been a small amount of "fragmentation" of marten habitat.

Drew (1995) found that martens foraged through areas of coniferous forest defoliated by spruce budworm and hemlock looper. In fact, these martens used defoliated stands more often than expected by simple random use. However, he also clarified this finding with "...while defoliated forest made up a significant portion of the home ranges of all but 1 marten in Newfoundland, the largest portion of all home ranges was intact mature and older coniferous forest".

Ivan and Seglund (2017) evaluated mammal and bird response in Colorado to the bark beetle outbreak. They determined there was no clear association between probability of use by American martens and levels of tree mortality or year since outbreak. Responses did not vary between lodgepole stands and spruce-fir stands. Martens continued to use pine beetle impacted stands.

Further, Kozlowski (2008) surmises that pure (<30% spruce-fir), mature lodgepole pine stands with high tree mortality levels will not provide marten habitat for 40 years, with only gradual improvements through 200 years. This is based on the facts that mature lodgepole provides quality habitat where structure is complex, overhead cover is present, and coarse woody debris is abundant. Sometimes, only isolated pockets within mature lodgepole adequately provide these characteristics for marten habitat.

Kozlowski (2008) also concludes that mixed conifer stands continue to improve as marten habitat over 200 years. Stands with a higher proportion of spruce-fir are comparatively higher quality marten habitat at any given time. These conclusions relate to the higher amounts of structural complexity, overhead cover, and coarse woody debris compared to lodgepole stands.

On the Medicine Bow National Forest, Dillon et al. (2003) indicated that coarse woody debris, which depends on long periods of forest development, is less common than the Historic Range of Variability (HRV) in high elevation forests due to past logging. Coarse woody debris was not required to be left during harvest operations decades ago. Dead and dying trees from the beetle outbreak are increasing amounts of coarse woody debris. Over time, there will be a particular benefit during winter as martens rely on coarse woody debris for improved survival in a subnivian environment (Kozlowski 2008).

From USDA (2003) concerns include: *Reduction in amount of post-fire habitat has removed prime habitat. Removal of snags (in harvested areas) has reduced potential nest sites. The amount of old forest is believed to be within the range typical of the past; but patch size and interior forest have been reduced. At a broad scale, two habitat types that are becoming rare in boreal forest are post-burn early-successional stands and old growth (Schmiegelow and Monkkonen 2002), the two types used by this species. Old forests have declined in area on the Medicine Bow (Welp et al. 2000). Though the current area may not be outside of the historic range of variation (HRV), it is at the low end; maintaining old growth at the low end of the range over long periods would be out of HRV in terms of long-term patterns (USDA 2003, citing Dillon and Knight et al. 2003; and Finch and Stangel 1992).*

Marten home range size requirements are disproportionately very large relative to body size, even compared to other carnivores (Buskirk and McDonald 1989 in Potvin et al. 2000). A recent analysis compiled by the USFS Rocky Mountain Regional Office listed marten abundance as uncommon, distribution in the region as patchy, and wide distribution outside of Region 2. They conclude that marten is widely distributed through the upper-elevation forests of Region 2 and is comparatively abundant at local scales where large amounts of quality habitat remain.

Extensive radio telemetry studies of American marten were conducted from 1985 through 1996 in the Coon Creek and East Fork Encampment River watersheds. Between 11 and 26 marten were trapped annually across two watersheds approximately 100 square miles in size (O'Doherty et al. 1997). A total of over 100 marten were eventually captured, radio-collared, released, and studied in the area. O'Doherty et al. (1997) found that marten home ranges in the Encampment River watershed were much larger than reported marten home ranges in other areas. Mean home ranges for martens in the Encampment River watershed on the Forest were found to be 1652 acres in summer and 1462 acres in winter for females and 4494 acres in summer and 3602 acres in winter for males. Female home ranges did overlap with male home ranges. Results of the study indicate that marten are widespread but uncommon on the Forest where suitable habitat is present.

Potential marten habitat across the Forest corresponds to spruce-fir forest of structural stages 4A through 4C and lodgepole of stages 4B and 4C. As noted earlier in this report, >500,000 acres were affected by insects and disease. This outbreak improved habitat in many areas with the addition of coarse woody debris. This outbreak decreased habitat in some locations where tree mortality was high in single-story lodgepole pine stands. Marten is a MIS for forest fragmentation/perforation and coarse woody debris. Fragmentation has not changed noticeably across the Forest since 2003 and coarse woody debris has started to accumulated after the insect/disease outbreak.

Since martens are uncommon and have disproportionately large home ranges, the Forest adopted a new survey technique in 2004 to monitor population trend. This hair snare technique is similar to the technique developed by Belant (2003). There were 62 hair snares; each monitoring the Forest for 11 to 14 days with 2 checks during this time. DNA from hair samples, and sometimes fecal samples, were used to determine individuals. Results for this Forestwide monitoring are provided in the table below. This method lost effectiveness over time as black bears became familiar with baits and increasingly tampered with survey stations. A trail camera methodology was employed in subsequent years to avoid bear impacts on results, see the second table below. Available data suggest that martens occur within suitable habitat across the Forest. These results are consistent with habitat summary provided earlier described earlier.

Table 17. Annual American marten hair snare monitoring results across the Forest.

Year	Total Marten Samples	# New Individuals	# Previously Identified Individuals
2004	14	7	na
2005	31	15	3
2006	15	5	2
2007	21	9	5
2008	5	1	2
2009	4	2	1
2010	10	6	1

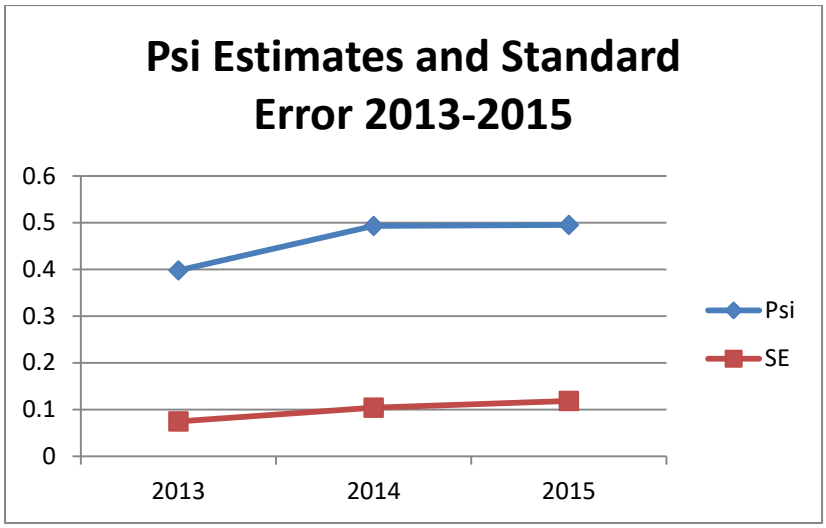

Figure 2. Annual American marten trail camera monitoring results across the Forest.

No Action Alternative

Direct and Indirect Effects

The insect and disease outbreak temporarily eliminated some suitable habitat in single-story lodgepole pine stands. Red squirrel prey has declined in these stands due to canopy reduction and loss of cone seeds (Saab et al. 2014). These stands will improve as marten habitat as coarse woody debris accumulates and stand regeneration continues over decades. Accumulated logs will bring these stands into HRV for woody debris (see Dillon et al. 2003), which promotes the abundance of red vole prey (Saab et al. 2014).

Marten habitat will be retained or improved in mixed conifer and spruce-fir stands, where tree mortality is lower. Coarse woody debris is increasing in these stands, providing winter resting sites, foraging sites, birthing dens, and improved prey habitat.

The beetle-killed trees in these stands will increase coarse woody debris over time. Understory productivity will increase, advanced regeneration growth rate will increase, and subalpine fir trees will become a larger component of these stands (Dhar et al. 2016, Malcolm 2012).

Subalpine fir trees have limbs that reach to the ground. In comparison, maturing lodgepole pine trees lose ground level limbs. The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells

2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to lynx habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The pine beetle outbreak detailed earlier has had little impact to martens so far (Ivan and Seglund 2017). So, impacted areas are still considered suitable habitat. Habitat quality in spruce-fir will be retained or improved due to retention of live cover and accumulation of some woody debris.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce marten habitat if they occur in stands with low or moderate tree mortality.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat (Forman et al 1997, Joslin and Youmans 1999). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system

for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Modified Proposed Action

Direct and Indirect Effects

There will be mixed effects of LAVA project implementation to American martens. However, the negative aspects of the LAVA project to MIS and Region 2 Sensitive wildlife are likely most pronounced in impacts to American marten habitat. Martens have not yet demonstrated a negative impact from the pine beetle outbreak (Ivan and Seglund 2017). Many prey animals have not declined significantly in response to insect/disease outbreaks (Stone 1995, Ivan and Seglund 2017) or have responded positively (Stone 1995, Saab et al. 2014) while red squirrels did respond negatively (Saab et al. 2014). Habitat and prey appear to be intact after insect/disease outbreaks.

In contrast, martens have responded negatively to some vegetation management and, perhaps, fragmentation. Martens respond negatively to removal of 20% to 35% of their home range (Potvin et al. 2000, Chapin et al. 1998, Bissonette et al. 1997). They have large home ranges and martens on this Forest have larger home ranges than those reported by other authors (O'Doherty et al. 1997). So, small amounts of vegetation management can impact much larger territories.

Several aspects of the project will reduce coarse woody debris, an important marten habitat component. Marten is an MIS for this Forest because of its relation to fragmentation and reliance on coarse woody debris. Marten is a Region 2 sensitive species due to its uncommon occurrence and negative response to some vegetation management.

Lodgepole pine stands with little or no understory do not provide quality marten habitat. Most of these stands also have high tree mortality rates. These stands have not regenerated sufficiently to provide quality habitat (Kozlowski 2008). Vegetation management and associated temporary roads in these stands will not affect marten habitat. Second, most of these stands are concentrated at the lower elevations near the forest edge where lodgepole is the climax species. So, vegetation management is

not likely to fragment 20% to 35% of a marten territory. These territories, comprised of mostly intact, older mixed conifer or spruce-fir forests, are often at higher elevations or on sites with more moisture than lodgepole climax stands.

Stand initiation treatments and associated temporary roads in lodgepole stands with understory trees (mixed conifer) provide marten habitat that will be impacted by vegetation management. The Forest's vegetation database suggests 4957 to 82,866 of the 95,000 acres of stand initiation treatment could be implemented because stands have reached CMAI. Field assessments in preparation for treatment will verify the final acreage of CMAI stands. These stands contain many live trees and some snags from the insect/disease outbreak. These stands also still support red squirrel prey. Stand initiation treatment and associated temporary roads will eliminate habitat in these stands. Regenerated areas will provide foraging habitat in several decades when more complex structure returns. Forest Plan Standards to retain recruitment trees, snags, and coarse woody debris will provide important habitat characteristics and facilitate the return to suitable habitat.

Secondly, regeneration of habitat will be delayed for stands that occur in the Forest's WUI areas. There are no Forest Plan requirements to retain snags, large, live recruitment trees, or coarse woody debris in WUI areas. Snags, large trees, and woody debris are important components of marten habitat, providing habitat components in future mature stands. There are about 360,000 acres of potential treatment opportunities within these WUI areas. So, a substantial amount of marten habitat will have delayed development and lower habitat quality.

Intermediate and "other" treatments and associated temporary roads will reduce habitat quality. These stands have lower levels of tree mortality, higher levels of woody debris, and are often the spruce-fir stands that provide the best habitat (USDA 2003, App. I). Habitat quality will be lightly to moderately reduced in habitat outside of WUI areas in the short to mid-term, directly related to the level of tree and snag removal. Where intermediate treatment methods are focused on small groups of trees not providing dense cover, regeneration of groups of live trees will promote habitat in the long term. Habitat quality will be greatly reduced in the Forest's WUI areas because there are no Forest Plan requirements to retain snags, large recruitment trees, or coarse woody debris in WUI areas. There are about 360,000 acres of potential treatment opportunities within these WUI areas. So, a substantial amount of marten habitat will have lower habitat quality and need years to decades to provide snags and coarse woody debris habitat components.

Steventon and Daust (2009) reviewed research on American marten habitat and harvest impacts. Then, they developed a comparative model to estimate the effects of a pine beetle outbreak and several harvest methods on likelihood of maintaining different marten population levels over 140 years as measured in female home ranges. They surmised that the beetle outbreak and initial salvage harvest for approximately 20 years caused a substantial marten population decline. Then, management options produced variable probabilities of achieving several long-term marten population recovery levels. Implementing partial cutting (30-70% overstory retention) for 50%, 33%, and 0% of the estimated annual harvest had the greatest to least, respectively, average long-term marten population levels. Reducing the annual harvest rate had the second greatest impact on marten population levels in the long term. Retaining the understory during operations had the next greatest impact. Maintaining the

status quo of clearcutting with <20% mature tree retention resulted in the lowest long-term marten population levels. This modeling suggests LAVA implementation will have moderate to very pronounced impacts on martens.

Where prescribed fire is the management tool, impacts are variable as described by Buskirk (2002): Southern red-backed voles and red squirrels are important prey of martens, and neither of these species would be positively affected by fire. However, wildfire has been shown to improve habitat quality for martens in Alaska and Yukon, at least in the short-term (Vernam 1987), where high densities of CWD are recruited to the forest floor, succession favors high densities of herbaceous plants in early successional stages, and small mammals respond positively to early post-fire successional stages. Where mature trees are killed and overstory canopy removed by prescribed fire, and post-fire successional stages do not generate a lot of physical structure near the ground, I predict that the loss of overstory canopy will reduce the ability of martens to traverse the area…Therefore, the effect of prescribed fire on marten habitat should depend on the value of the habitat to martens before the fire, on fire characteristics, on whether overstory-producing trees are killed, and on post-fire successional trajectories.

For marten, there are also considerations for the pattern of habitat loss. Martens do not tolerate 20% to 35% conversion of a home range to nonforested cover (Potvin et al. 2000, Chapin et al. 1998, Bissonette et al. 1997). So, vegetation management in only a portion of a territory might discontinue use of that territory. Old growth stands, which provide marten habitat, will be maintained according to Forest Plan standards. However, LAVA project also includes vegetation management in wildlife security areas and designated roadless areas. In many cases these areas incur limited vegetation management and act as buffers to retain some wildlife habitats.

Security areas (Hillis et al. 1991) are blocks of forested cover $\geq$1/2 mile from an open road and $\geq$250 acres in size. Security areas were originally defined for bull elk survival but these large areas of cover free of disturbance are important for many wildlife species, including martens (USDA 2003, p. 3-262). Some amount of marten habitat in security areas and roadless areas will be treated. That total will be determined by on site field surveys but the amount could be considerable. For example, there could be 35,000 acres of vegetation management in marten habitat in 25 roadless areas. The end result is that some marten territories will be affected in areas where management effects do not often occur.

Temporary roads will be obliterated and returned to the land base within 3 years under all intermediate and “other” treatment methods. Obliteration methods are described in design criteria in the draft EIS. Regeneration to suitable habitat will occur in similar time frames to regeneration within stand initiation treatment areas.

Forest Plan standards to retain 15% lodgepole, 25% ponderosa pine, and 25% spruce-fir old growth by mountain range will ensure that additional marten habitat is present on the landscape.

Noise associated with the machinery use, tools, and fire of treatment implementation can cause temporary disturbance to wildlife (see Forman et al.1997, Wisdom et al. 2005). Individuals could leave the immediate area during this brief period but could return after treatment is completed where habitat

still exists. The temporary disturbances caused by these short-term activities are not expected to cause decreased reproductive success or survival across the population.

Impacts of the proposed actions to American martens by Accounting Unit (AU) can be estimated by several factors. For example, where the percentage of a species habitat in an AU is high or the acres in a No Treatment Area in habitat is high, then impacts to species habitat are less. Areas within lynx habitat cannot exceed treatment parameters and related exemptions and exceptions identified in the Southern Rockies lynx amendment, so impacts to marten would parallel the resulting condition of overlapping Lynx Analysis Units (LAU). Where tree mortality is higher, especially in single story lodgepole, vegetation management has little or no impact to habitat. On the other hand, where the percentage of an AU that is within WUI is high, the treatment impacts to habitat can be more pronounced because snags, large recruitment trees, and coarse woody debris do not have to be retained in treated areas. These habitat features are important to species that use old forest. Impacts of proposed actions are summarized in the table below.

Table 18. Impacts of Proposed Actions to American Marten by Accounting Unit

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	High	High	Low	Low	Medium	Medium
Big Blackhall	Medium	Medium	Medium	Low	Medium	Medium
BowKettle	High	Low	Low	Low	Medium	Low
CedarBrush	High	Low	Low	Medium	Medium	Low
FoxWood	Low	Low	Low	Linkage Medium	Low	Low
FrenchDouglas	Medium	Medium	Low	Medium	Medium	Medium
GreenHog	Medium	High	Low	Low	Medium	Medium
JackSavery	High	Low	Low	Low	Low	Low
NorthCorner	High	Medium	Low	Medium	Medium	Medium
OwenSheep	Low	Low	Low	Na	Low	Low
PeltonPlatte	Low	High	Low	Linkage Medium	High	Medium
RockMorgan	High	High	Low	Medium	Medium	Medium

SandyBattle	Low	Low	Low	Na	Low	Low
WestFrench	High	Low	Low	Medium	Medium	Low

Cumulative Effects

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The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The pine beetle outbreak detailed earlier has had little impact to martens so far (Ivan and Seglund 2017). So, impacted areas are still considered suitable habitat. Habitat quality in spruce-fir will be retained or improved due to retention of live cover and accumulation of some woody debris.

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Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce marten habitat if they occur in stands with low or moderate tree mortality.

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Transportation System: Roads can have impacts to wildlife and habitat (Forman et al 1997, Joslin and Youmans 1999). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system

for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

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Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

A "may adversely impact individuals, but not likely to result in a loss of viability on the Planning Area, nor cause a trend to federal listing or a loss of species viability rangewide" determination is made for American marten. Some habitat will remain across the Forest for martens based on the following:

- This project impacts some habitat, reduces some habitat quality, and regenerates some areas not currently suitable habitat.
- Stands of designated old growth will be retained across the mountain ranges according to Forest Plan Standards (USDA 2003), maintaining some habitat.
- Some treatment will occur in designated roadless areas, reducing marten habitat often unaffected by management actions.
- Snags, recruitment trees, and coarse woody debris may not be retained in WUI treatment areas, reducing marten habitat.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Northern goshawk – MIS/Sensitive Species

Existing Condition

Northern goshawks (*Accipiter gentilis*) appear to be relatively abundant on the MBNF. Goshawks are found well distributed across the forest and are regular breeding birds. There are more than 300 recorded nests on the MBNF (records in the Wyoming Natural Diversity Database, District survey records, and NRIS Wildlife database). Forest-wide goshawk population trend appears stable. However, there is an

expectation that the population will decline in the near future due to the pine beetle outbreak (Skorkowsky 2009).

Goshawks breed in coniferous, deciduous, and mixed forests throughout North America (Reynolds et al. 1992). Preferred habitat during the breeding season is older, tall forests where goshawks can maneuver in and below the canopy while foraging and where they can find large trees in which to nest (Squires and Ruggiero 1996). In the Rocky Mountains, goshawks frequently nest in dense stands of mature lodgepole pine or quaking aspen below 9200 ft. elevation (Squires and Ruggiero 1996). Because of its relatively large body size and wing span, the goshawk does not often use dense, young forest stands.

Management recommendations for goshawks have been developed for the Southwest Region (R3) of the Forest Service (Reynolds 1983, Reynolds et al. 1992). Since many of the forested habitat types in the Southwest (primarily ponderosa pine) differ from those in the central Rocky Mountains, Region 2 has not formally adopted the R3 management recommendations. However, some interpretations may be made which are loosely based on some of the Southwestern management criteria.

Home ranges for goshawks may be up to 6,000 acres, and Reynolds et al. (1992) identified three main components needed within this home range for southwestern forests. The nest area is 30 acres or more in size and may include more than one nest. Nest areas contain one or more stands of large, old trees with a dense canopy cover. Most goshawks have alternate nest areas within their home range that may be used in different years. The post fledging-family area (PFA) is approximately 420 acres and surrounds the nest area.

Because of its size, the PFA typically includes a variety of forest types and conditions. It represents an area of concentrated use by the family from the time the young leave the nest until they are no longer dependent on the adults for food (up to two months). These areas are important for fledglings since they provide hiding cover and prey on which to develop hunting skills. PFA's have patches of dense trees, developed herbaceous and/or shrubby understories, and habitat attributes such as snags, downed logs, and small openings that provide necessary habitat for many goshawk prey species. The foraging area is approximately 5,400 acres in size, and surrounds the PFA. Hunting goshawks use available habitats opportunistically. This suggests that the choice of foraging habitat may be as closely tied to prey availability as to habitat structure and composition.

Limiting Factors (from USDA (2003), Kennedy 2003)
Goshawks are sensitive to disturbance at nest sites, with one study finding camping near nest sites leading to nest failure (Speiser 1992 in Kennedy 2003). In compliance with the MBNF Forest Plan Standards and Guidelines, harvest activities will be performed within specified time windows (August 30 – April 1) to restrict disturbance during breeding season. When activities fall outside these time windows there will be a .25 mile buffer between any active nest and harvest activities. This buffer is designed to limit disturbance put on nesting goshawks.

The primary threat to Goshawks is habitat loss through timber harvest (Kennedy 2003). This amounts to loss of stands of live mature/old trees with interlocking crowns, primarily lodgepole pine and aspen in the analysis area (AA).

There is suitable habitat and known nest sites within the project area of LaVA. The Sierra Madre Range (SMR) contains approximately 166,172 acres of preferred goshawk habitat (Table 19). Preferred habitat is herein defined as lodgepole pine medium, large – very large size class, aspen medium, large – very large size class dominant stands.

The Snowy Range (SR) contains approximately 220,553 acres of preferred goshawk habitat (Table 19). Total preferred habitat between the two mountain ranges is estimated at 386,725 acres, if all stands were alive with interlocking crowns.

According to GIS data in FSVegSpatial, total acreage (SR + SMR) of preferred habitat types is approximately 95,624 acres. This amounts to stands that are predominantly lodgepole pine or quaking aspen, size class large or very large, less than 50% mortality.

Table 19. Dominant vegetation by mountain range (FSVeg) not accounting for mortality

Sierra Madre							
FSVeg Species	ALL	Established	Small	Medium	Large	Very Large	% of Mountain range
Forbs/ Grasses	135680						34
Barren	4044						1
Shrub	10810	0	428	4456	5926	0	3
Aspen	54869	1444	1980	33446	17914	85	14
Ponderosa pine (PP)	0						0
Douglas-fir (DF)	730			8	591	131	0
Lodgepole pine (LP)	132682	6826	11129	56250	58127	350	33
Spruce-fir (SF)	61102	3208	824	9362	44784	2924	15
Limber pine (LM)	56				56		0
Cottonwood	202			43	159		0
1–Established = < 1”dbh, Small = 1-4.9”dbh, Medium = 5-8.9”dbh, Large = 9-15.9”dbh, very large = > 16”dbh							
2- acres shown are for NFS land only							

Snowy Range							
FSVeg Species	ALL	Established	Small	Medium	Large	Very Large	% of Mountain Range
Forbs/ Grasses	131743						23
Barren	4344						1
Shrub	3811		2640	977	194		1
Willow	13523		94	12470	959		2

Aspen	22916	704	2867	10925	8414	6	4
Ponderosa pine (PP)	162				19	143	0
Douglas-fir (DF)	6476	243		2693	3143	397	1
Lodgepole pine (LP)	269957	16067	52682	113848	86447	913	47
Spruce-fir (SF)	120223	6429	9850	20993	71038	11913	21
Limber pine (LM)	957		22	157	676	102	0
Rocky MTN Juniper	33			33			0
Cottonwood	255			53	69	133	0
1–Established = < 1”dbh, Small = 1-4.9”dbh, Medium = 5-8.9”dbh, Large = 9-15.9”dbh, very large = > 16”dbh							
2- acres shown are for NFS land only							

*Total acreages in table 10 do not differentiate between living and dead within a size class

Ratio of trees living to dead varies widely from stand to stand. Lodgepole stands with more trees dead are consistently made up of older/larger size classes. Overall, many older lodgepole pine stands within the analysis area constitute poor habitat in the wake of the pine beetle outbreak. By the definition given above for preferred habitat for the species, the Snowy Range and Sierra Madre Range have far fewer acres currently present for northern goshawks than is illustrated in table 19.

In the NRIS Wildlife database there are 386 occurrences of northern goshawks in the SR and SMR between 2004 and 2017, many of the records documenting 3-4 birds in a sighting (family group).

In 2016 active nests were located in 3 territories and nesting was documented at 3 historic nest locations within stands affected by beetle kill in the SR. One of those nests failed to fledge any chicks. In 2017 no active nests were located in the SR. This could be due to the stands becoming unusable to goshawks and/or prey species, or it could be a natural low point in population/breeding activity.

No Action Alternative

Direct and Indirect Effects

The insect and disease outbreak led to a sharp decrease in ideal goshawk habitat. The outbreak affected size class large and very large trees, primarily lodgepole pine. Unfortunate for the goshawk, lodgepole pine in these size classes are also the preferred nesting trees for the species in absence of aspen. On the SR, aspen is a relatively uncommon species, occurring in small pockets. Aspen is more common in the SM.

While goshawks have been documented using stands of dead lodgepole pine in the SR and SM Ranges, it is unknown how long such stands will support breeding for the species. One such stand in the SR had a documented nest in 2015 which was successful and fledged three chicks. The same nest failed in 2016, and in 2017 the nest was not used by the species. While three years does not necessarily make a trend, it is plausible that since seed production is no longer occurring in dead stands, goshawk prey species such as red squirrels occur at much lower densities now than they did prior to the outbreak. Reductions in prey equate to a loss in usable habitat.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to wildlife habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

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The pine beetle outbreak detailed earlier created an overall reduction in habitat quality by killing large trees commonly used for nesting. Resulting snags would provide nesting habitat as long as there was a seed bank from the previously-living trees to feed prey species. These areas would still be suitable habitat where tree mortality is low to moderate. Habitat would no longer be suitable where tree mortality is high.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce goshawk habitat if they occur in stands with low or moderate tree mortality.

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Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Goshawks typically will not nest near roads, though there are historic nests less than 100m from roads. These nests are mostly defunct, having been left unused for 10 years or more in some cases. So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

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Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Modified Proposed Action

Direct and Indirect Effects

LaVA potential effects to species will vary from one analysis unit (AU) to the next dependent on a variety of factors (i.e. how much of the AU is in wilderness or other excluded area, how much has been treated in previous projects, etc). In table 20 and 21 below is an analysis of current goshawk habitat estimates within the two mountain ranges included in analysis.

Table 20. Habitat and treatment opportunity acres in analysis units in the Sierra Madre Range. Habitat is defined as lodgepole pine or aspen-dominant, size class large or very large, less than 50% mortality as found in FSVeg spatial layer.

Analysis Unit	Jack Savery	Sandy Battle	Battle Pass	Green Hog	Big Blackhall

Total Acres	Acres available for SISS	Acres available for green tree	Acres intermediate treatment	Estimated Acres Current Habitat	Total Estimated Habitat in Mountain Range
79,138	29,734	31,460	30,733	11,989	70,636
94,484	27,044	32,765	13,820	18,907	
49,436	13,639	15,371	12,614	9,671	
65,940	12,347	15,454	12,139	15,632	
73,222	19,895	15,674	14,321	14,437	

Table 18. Habitat and treatment opportunity acres in analysis units in the Snowy Range. Habitat is defined as lodgepole pine or aspen-dominant, size class large or very large, less than 50% mortality as found in FSVeg spatial layer.

Analysis Unit	Total Acres	Acres Available for SISS
Pelton Platte	49,297	5,802
Fox Wood	85,609	35,130
Owen Sheep	28,798	28,798
French Douglas	66,086	17,322
West French	69,697	18,296
North Corner	45,106	15,723
Rock Morgan	62,487	14,059
Cedar Brush	60,899	10,725
Bow Kettle	64,493	14,026

Acres available green tree	Acres intermediate treatment	Estimated Acres Current Habitat	Total Estimated Habitat in Mountain Range
6,439	4,242	4,394	84,921
34,077	18,342	11,241	
6,138	4,186	6,384	
23,941	11,080	9,986	
25,576	14,790	12,690	
10,550	15,095	4,743	
19,459	16,580	14,842	
22,852	14,327	11,122	
23,692	14,471	9,519	

Table 19. Potential effects to northern goshawk habitat through treatments.

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	Medium	Medium	Low	Low	High	Medium
Big Blackhall	High	Medium	Medium	Low	High	High
BowKettle	Medium	Low	Low	Low	High	Medium
CedarBrush	High	Low	Low	Medium	High	Medium
FoxWood	Medium	Low	Low	Linkage Medium	Low	Low
FrenchDouglas	Medium	Medium	Low	Medium	Medium	Medium
GreenHog	Medium	Medium	Low	Low	High	Medium
JackSavery	Medium	Low	Low	Low	High	Medium
NorthCorner	Low	Medium	Low	Medium	Low	Low

OwenSheep	High	Low	Low	Na	High	High
PeltonPlatte	Medium	High	Low	Linkage Medium	High	Medium
RockMorgan	High	High	Low	Medium	High	High
SandyBattle	Medium	Medium	Low	Na	Medium	Medium
WestFrench	Medium	Low	Low	Medium	High	Medium

Stand initiation treatments (SISS)

The LaVA project proposes stand-initiating treatments be applied to up to 95,000 acres over the life of the project. The intention is to primarily treat stands which have been killed during the MPB epidemic.

The option is available to apply stand-initiating treatments to live stands that have reached 95% or higher CMAI. Highest estimates of these potential treatments indicate between 4,957 acres and 82,866 acres are available for these treatments.

For the purpose of this analysis, I will assume "worst-case" scenario for the northern goshawk. This highly unlikely scenario implies that stand-initiating treatments will be applied to 82,866 acres of green trees, leaving less than 13,000 acres of this type of treatment in dead, dying, and diseased stands.

After 95,000 acres are treated between the Snowy Range and Sierra Madre Range, assuming 82,866 acres were green lodgepole or aspen stands, size class large or very large treated, approximately 72,691 out of the current 155,557 acres (see tables 20 and 21 above) will continue to be available to northern goshawks. These acres will be distributed between the SM and SR.

This constitutes a drastic decline in habitat. While this species may continue using stands with dead trees or smaller trees, they will likely experience a reduction in nesting success doing so.

With timber harvest comes noisy machinery. Should treatment occur within 0.25 miles of an active nest, there is a high probability that the nesting birds will be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Smoke from prescribed burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could potentially cause an active nest to fail or individuals to avoid the area temporarily.

Intermediate/Uneven-aged Treatments

LaVA proposes up to 165,000 acres in intermediate treatments. These treatments would not revert stands to a re-initiation stage. They may, however, remove the large trees from a stand to open up the understory to growth, or remove clumps of trees, creating an uneven aged stand, or a variety of other options.

Intermediate treatments, depending on method used, may be beneficial to goshawks and their habitat. They could create better conditions for prey species by reducing the understory, or improve the quality of stands through thinning operations leading to larger nesting trees and larger spaces between trees for increased hunting success.

Of course, intermediate treatments may be detrimental to the species as well. For example, overstory removal could remove all seed-producing trees, eliminating habitat for multiple prey species such as red squirrels and seed-eating songbirds until the understory matures and begins producing cones.

Intermediate treatments, as with stand-initiation treatments, are planned to take place primarily in areas of heavy beetle kill. While goshawks may use these areas, and nests have produced offspring, it is unknown how successful their nesting attempts are in these areas or how long dead stands will continue to be selected and used for nesting.

Noise from machinery and vehicles has the possibility of affecting goshawks with this treatment type as well. Should treatment occur within 0.25 miles of an active nest, there is a high probability that the nesting birds will be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Smoke from prescribed burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could potentially cause an active nest to fail or individuals to avoid the area temporarily.

Other Treatments

LaVA proposes up to 100,000 acres of 'other' treatment types. This could be shrub removal, conifer encroachment, jackpot burning, or various other treatments related to the understory. This type of treatment is less likely to occur in goshawk habitat. It is possible however that a shrub removal/fuels reduction or other project may occur within or near goshawk habitat.

Also included in this treatment category is coppice cuts, which will lead to regeneration of aspen stands through clear-cut treatments of this species.

Coppice cuts in large aspen will affect goshawk habitat through direct removal of potential nesting habitat.

Potential direct effects to goshawks through understory treatments are unlikely. Smoke from brush burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could cause an active nest to fail or individuals to avoid the area temporarily.

Noise from machinery and vehicles brings with it the possibility of affecting goshawks in these treatment types as well. Should treatment occur within 0.25 miles of an active nest, there is a high probability that the nesting birds will be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The pine beetle outbreak detailed earlier created an overall reduction in habitat quality by killing large trees commonly used for nesting. Resulting snags would provide nesting habitat as long as there was a seed bank from the previously-living trees to feed prey species. These areas would still be suitable habitat where tree mortality is low to moderate. Habitat would no longer be suitable where tree mortality is high.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce northern goshawk habitat if they occur in stands with low or moderate tree mortality.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Brown creepers have been found to avoid habitat within 100m of roads (Hutto 1995). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface

replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

Some habitat will remain across the Forest for northern goshawks based on the following:

- This project impacts some habitat, reduces some habitat quality, regenerates some areas, and has the potential to improve some habitat in the long-term where dead lodgepole pine stands are regenerated.
- Forest Plan guideline to consult Partners-in-Flight Conservation Plans (p. 1-40) for additional guidance was accomplished. Northern goshawk is a Level I priority species.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Flammulated Owl – Sensitive Species

Existing Condition

Flammulated owls (*Otus flammeolus*) are known to occur from southern British Columbia south and eastward to Guatemala and probably El Salvador. It is very rarely found outside of montane forests, usually open conifer forests containing pines (Hayward and Verner 1994). *O. flammeolus*, in the past, was considered a rare species by many. In more recent years it has been found to be a widespread but secretive species (Hayward and Verner 1994).

Originally the species was thought to be non-migratory. However, since the discovery that they are strictly insectivorous the conclusion was made they do in fact migrate to and from winter range (Hayward and Verner 1994).

Their nesting locations are dependent upon cavities excavated previously by woodpeckers. The species inhabits mid-elevation montane forests of ponderosa pine (Pinus ponderosa) and Jeffrey pine (Pinus jeffreyi) during breeding season across western North America (Nelson et al 2009). The species will also nest in living or dead quaking aspen stands (Populus tremuloides) (POTR) (Linkhart and Reynolds 1997). Flammulated owls occur in stands of mature and older aspen on the west side of the Sierra Madre Range where these stands are a large component of the landscape. The species is not known to occur in the lodgepole pine (Pinus contorta) forests of Wyoming (Hayward and Verner 1994). Little is known about the species' nonbreeding range in Mexico and Central America.

There are approximately 8,614 acres within the AA where the dominant vegetation includes ponderosa pine (PIPO) or douglas fir (Pseudotsuga menziesii) (PSME). There are approximately 15,000 acres of mature aspen habitat on the west side of the Sierra Madre Range. The beetle infestation did not affect these acres like it did the lodgepole pine dominant areas, and over three-quarters of these acres are estimated to contain 49% or less mortality, with a large majority of acres estimated at or near 0% mortality. This acreage accounts for less than 10% of the AA.

There have been 22 observations of the species entered into NRIS Wildlife in the AA, all of them in the SMR. Most observations have been on the western end of the SMR, with only two on the eastern edge, and a third just outside of the Forest's eastern edge. All on-Forest observations were in or immediately outside of PIPO, POTR, or PSME habitat types. There is no habitat data for the observation outside the Forest boundary.

The species is often undetected even where it is abundant because it breeds and calls at night in late spring. As a result, the species is often missed both by night-time surveys for owls (mostly done in winter, when most owls breed) and by spring bird surveys (done after sunrise, when most songbirds are singing.) The species may be more widespread in the limited ponderosa pine found on the MBNF than recorded sightings indicate.

Common results of survey work focused on the species indicate an absence in timber harvest areas (Hayward and Verner 1994). Marshall (1988) revisited the site of his earlier study (1939) and found flammulated owls absent from a portion of the study area which had been logged. Marshall also surveyed Sutton and Burleigh's site in Veracruz (1940) and failed to find the species. Franzreb and Ohmart also observed the owls were present in mixed-conifer forest but absent from nearby logged sites (1978).

No Action Alternative

Direct and Indirect Effects

The insect and disease outbreak has affected mainly lodgepole pine, and to a much lesser degree spruce/fir forest types. For flammulated owls, a species with preferences leaning toward ponderosa pine and aspen forest types, current conditions are relatively favorable. Ponderosa pine forest types are not common within the project area. The only observations on the Forest have occurred in the Sierra Madre Range, in aspen stands. Aspen stands in the SM are common and in varying degrees of health.

The main natural factor influencing wildlife habitat is the insect/disease outbreak. Under the no action alternative, there are few impacts to wildlife, as no human-influenced vegetation management activity would occur. Lodgepole stands with high mortality most often exist as unsuitable habitat for several decades. Canopy cover and conifer tree seed production have declined substantially in the short term.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to wildlife habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments will not reduce flammulated owl habitat as ponderosa pine stands do not occur within their analysis areas, and the species is not known to occur within the small aspen patches on the Snowy Range.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. In previous surveys in another state, I have found flammulated owls will utilize habitat within 100m of roads. Still, it is possible the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known major utility proposals affecting the project area.

Modified Proposed Action

Direct and Indirect Effects

LaVA potential effects to species will vary from one analysis unit (AU) to the next dependent on a variety of factors (i.e. how much of the AU is in wilderness or other excluded area, how much has been treated in previous projects, etc). In table 23 and 24 below is an analysis of current flammulated owl habitat estimates within the two mountain ranges included in analysis.

Table 20. Habitat and treatment opportunity acres in analysis units in the Sierra Madre Range. Habitat is defined as ponderosa pine or aspen stands as found in FSVeg spatial layer.

Analysis Unit	Jack Savery	Sandy Battle	Battle Pass	Green Hog	Big Blackhall
Total Acres	79,138	94,484	49,436	65,940	73,222

Acres available for SISS	Acres available for green tree	Acres intermediate treatment	Estimated Acres Current Habitat	Total Estimated Habitat in Mountain Range
29,734	31,460	30,733	2,702	42,396
27,044	32,765	13,820	25,905	
13,639	15,371	12,614	3,737	
12,347	15,454	12,139	6,318	
19,895	15,674	14,321	3,734	

Table 21. Habitat and treatment opportunity acres in analysis units in the Snowy Range. Habitat is defined as ponderosa pine or aspen stands as found in FSVeg spatial layer.

Analysis Unit	Total Acres	Acres Available for SISS	Acres available green tree
Pelton Platte	49,297	5,802	6,439
Fox Wood	85,609	35,130	34,077
Owen Sheep	28,798	28,798	6,138
French Douglas	66,086	17,322	23,941
West French	69,697	18,296	25,576
North Corner	45,106	15,723	10,550
Rock Morgan	62,487	14,059	19,459
Cedar Brush	60,899	10,725	22,852
Bow Kettle	64,493	14,026	23,692

Acres intermediate treatment	Estimated Acres Current Habitat	Total Estimated Habitat in Mountain Range
4,242	1,993	17,380
18,342	1,681	
4,186	634	
11,080	370	
14,790	2,946	
15,095	961	
16,580	743	
14,327	3,510	
14,471	4,542	

Table 22. Potential habitat condition for Flammulated owl after treatments by AU.

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	Medium	Medium	Low	Low	High	Medium
Big Blackhall	Low	Medium	Medium	Low	High	Medium
BowKettle	Low	Low	Low	Low	High	Low
CedarBrush	Low	Low	Low	Medium	High	Low
FoxWood	Medium	Low	Low	Linkage Medium	Low	Low
FrenchDouglas	Low	Medium	Low	Medium	Low	Low
GreenHog	Medium	Medium	Low	Low	High	Medium
JackSavery	Low	Low	Low	Low	High	Low
NorthCorner	Low	Medium	Low	Medium	Low	Low

OwenSheep	Low	Low	Low	Na	Medium	Low
PeltonPlatte	Medium	High	Low	Linkage Medium	High	Medium
RockMorgan	Low	High	Low	Medium	Medium	Medium
SandyBattle	High	Medium	Low	Na	High	High
WestFrench	Medium	Low	Low	Medium	Medium	Low

Stand initiation treatments (SISS)

The LaVA project proposes stand-initiating treatments be applied to up to 95,000 acres over the life of the project. These treatments will remove the overstory to regenerate the stand. The intention is to primarily treat stands which have been killed during the MPB epidemic.

The option is available to apply stand-initiating treatments to live stands that have reached 95% or higher CMAI. Highest estimates of these potential treatments indicate between 4,957 acres and 82,866 acres are available for these treatments.

This treatment type applies to conifer forest types, not forest types associated with the flammulated owl as they exist on the Sierra Madre Range.

While these treatments will not directly affect flammulated owl habitat, there is a chance of indirect effects such as noise disturbance. With timber harvest comes noisy machinery. Should treatment occur near an active nest, there is a high probability that the nesting birds may be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Smoke from prescribed burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could potentially cause an active nest to fail or individuals to avoid the area temporarily.

Intermediate/Uneven-aged Treatments

LaVA proposes up to 165,000 acres in intermediate treatments. These treatments would not revert stands to a re-initiation stage. They may, however, remove the large trees from a stand to open up the understory to growth, or remove clumps of trees, creating an uneven aged stand, or a variety of other options.

Intermediate treatments, depending on method used, may be beneficial to flammulated owls and their habitat. They could improve the quality of stands through thinning operations leading to larger nesting trees.

Intermediate treatments, as with stand-initiation treatments, are planned to take place primarily in areas of heavy beetle kill. These areas are not known to be used by the flammulated owl on the Medicine Bow National Forest.

Noise from machinery and vehicles has the possibility of affecting flammulated owls with this treatment type as well. Should treatment occur near an active nest, there is a chance that the nesting birds will be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Smoke from prescribed burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could potentially cause an active nest to fail or individuals to avoid the area temporarily.

Other Treatments

LaVA proposes up to 100,000 acres of 'other' treatment types. This could be shrub removal, conifer encroachment, jackpot burning, or various other treatments related to the understory. This type of treatment is less likely to occur in goshawk habitat. It is possible however that a shrub removal/fuels reduction or other project may occur within or near flammulated owl habitat. Also included in this treatment category is coppice cuts, which will lead to regeneration of aspen stands through clear-cut treatments of this species.

Coppice cuts in large aspen will affect flammulated owl habitat through direct removal of potential nesting habitat.

Potential direct effects to flammulated owls through understory treatments are unlikely. Smoke from brush burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could cause an active nest to fail or individuals to avoid the area temporarily.

Noise from machinery and vehicles brings with it the possibility of affecting flammulated owls in these treatment types as well. Should treatment occur near an active nest, there is a high probability that the nesting birds will be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These projects are unlikely to affect flammulated owls or their habitat, as they are designed around conifer treatments and the species is only known to occur in aspen on this Forest.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. In previous surveys in other areas, I have found flammulated owls will utilize habitat within 100m of roads. Still, the current road network may be reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

Some habitat will remain across the Forest for flammulated owls based on the following:

- Flammulated owls are not known to occur in the Snowy Range; the species has only been documented in the Sierra Madre Range and other units outside of this analysis.
- This project impacts some habitat, reduces some habitat quality, regenerates some areas, and has the potential to improve some habitat in the long-term where aspen stands are released from pine encroachment.
- Forest Plan guideline to consult Partners-in-Flight Conservation Plans (p. 1-40) for additional guidance was accomplished. Flammulated owl is not listed as a priority species in Wyoming.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Purple Martin – Sensitive Species

Existing Condition

Purple martin (*Progne subis*) is not a common species on the Medicine Bow National Forest. They have been known to breed in one part of the Sierra Madre Range in the past, with no known nesting attempts in recent years. They are not known to occur in the Snowy Range. Purple martin is a Tier III species of concern according to Wyoming Game and Fish Department, indicating it is considered a species of greatest conservation need, third tier (falling in the "Moderate" mitigation category – lowest priority).

There are 50 records of purple martin in the NRIS Wildlife database. All 50 records are in Colorado, on the Routt National Forest. In Colorado, purple martin commonly nest in aspen, spruce/fir, or mixed spruce/fir and aspen stands adjacent to a forest opening (Reynolds *et al* 2002). Reynolds *et al* also found that every nest located in their study was in a cavity excavated by woodpeckers – all holes appeared to be excavated by northern flickers based on measurements (2002).

There have been only two years of known breeding or occurrence of purple martin in the SMR. The first of those years was the first sighting of the species in the state of Wyoming in 99 years (Loose, personal communication 2017). There have been no known instances of individuals or nesting in recent years.

Nesting cavities may occur in live trees as well as dead. Past nesting in the SMR occurred exclusively in stands of very large old aspen near sagebrush, and with open water such as a pond nearby. In the eastern U.S. the species has very little nesting habitat and relies almost entirely on large nesting boxes, where multiple pairs will raise their young in a "community." In the west, such nest boxes are uncommon, and pairs will take up residence in large aspen trees excavated by woodpeckers. They have been observed nesting in groups, with one pair per tree, but other pairs nesting in nearby trees (Loose, personal communication 2017, Reynolds *et al* 2002).

With their nesting preferences guiding them to such specific areas (very large old aspen near both sagebrush and open water) and very infrequent documented nesting in south-central Wyoming, it is unlikely there will ever be an established population on the Medicine Bow National Forest.

No Action Alternative

Direct and Indirect Effects

The insect and disease outbreak has affected mainly lodgepole pine, and to a much lesser degree spruce/fir forest types. For purple martin, a species with preferences leaning toward aspen forest types, current conditions are relatively favorable. The only observations on the Forest have occurred in the Sierra Madre Range, in aspen stands near both open water and sagebrush. Aspen stands are relatively common and in varying degrees of health in the Medicine Bow National Forest.

The main natural factor influencing wildlife habitat is the insect/disease outbreak. Under the no action alternative, there are few impacts to wildlife, as no human-influenced vegetation management activity would occur.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to wildlife habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek

area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments will not reduce purple martin habitat as aspen is not a focus in these projects.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Studies on the effects of roads on purple martin are largely non-existent. However, Hutto (1993) found many passerine species to be affected by the presence of roads. It is possible the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Modified Proposed Action

LaVA potential effects to species will vary from one analysis unit (AU) to the next dependent on a variety of factors (i.e. how much of the AU is in wilderness or other excluded area, how much has been treated in previous projects, etc). In table 26 and 27 below is an analysis of current purple martin habitat estimates within the two mountain ranges included in analysis. Under this analysis all aspen stands as shown in FSVeg Spatial in GIS are analyzed as habitat.

Table 23. Habitat and treatment opportunity acres in analysis units in the Sierra Madre Range by AU.

Analysis Unit	Total Acres	Acres available for SISS	Acres available for green tree	Acres intermediate treatment	Estimated Acres Current Habitat	Total Estimated Habitat in Mountain Range
Jack Savery	79,138	29,734	31,460	30,733	2,702	42,396
Sandy Battle	94,484	27,044	32,765	13,820	25,905	
Battle Pass	49,436	13,639	15,371	12,614	3,737	
Green Hog	65,940	12,347	15,454	12,139	6,318	
Big Blackhall	73,222	19,895	15,674	14,321	3,734	

Table 24. Habitat and treatment opportunity acres in analysis units in the Snowy Range by AU.

Analysis Unit	Total Acres	Acres Available for SISS	Acres available green tree	Acres intermediate treatment	Estimated Acres Current Habitat	Total Estimated Habitat in Mountain Range
Pelton Platte	49,297	5,802	6,439	4,242	1,849	17,217
Fox Wood	85,609	35,130	34,077	18,342	1,681	
Owen Sheep	28,798	28,798	6,138	4,186	634	
French Douglas	66,086	17,322	23,941	11,080	370	
West French	69,697	18,296	25,576	14,790	2,927	
North Corner	45,106	15,723	10,550	15,095	961	
Rock Morgan	62,487	14,059	19,459	16,580	743	
Cedar Brush	60,899	10,725	22,852	14,327	3,510	
Bow Kettle	64,493	14,026	23,692	14,471	4,542	

Table 25. Potential effects to purple martin habitat through treatments by AU

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity

BattlePass	Low	Medium	Low	Low	High	Low
Big Blackhall	Low	Medium	Medium	Low	High	Medium
BowKettle	Low	Low	Low	Low	High	Low
CedarBrush	Low	Low	Low	Medium	High	Low
FoxWood	Medium	Low	Low	Linkage Medium	Low	Low
FrenchDouglas	Low	Medium	Low	Medium	Low	Low
GreenHog	Medium	Medium	Low	Low	High	Medium
JackSavery	Low	Low	Low	Low	High	Low
NorthCorner	Low	Medium	Low	Medium	Low	Low
OwenSheep	Low	Low	Low	Na	Medium	Low
PeltonPlatte	Medium	High	Low	Linkage Medium	High	Medium
RockMorgan	Low	High	Low	Medium	Medium	Medium
SandyBattle	High	Medium	Low	Na	High	High
WestFrench	Medium	Low	Low	Medium	Medium	Low

Stand initiation treatments (SISS)

The LaVA project proposes stand-initiating treatments be applied to up to 95,000 acres over the life of the project. The intention is primarily to treat stands which have been killed during the MPB epidemic.

The option is available to apply stand-initiating treatments to live stands that have reached 95% or higher CMAI. Highest estimates of these potential treatments indicate between 4,957 acres and 82,866 acres are available for these treatments.

This treatment type applies to conifer forest types, not forest types associated with the purple martin.

While these treatments will not directly affect purple martin habitat, there is a chance of indirect effects such as noise disturbance. With timber harvest comes noisy machinery. Should treatment occur near an active nest, there is a high probability that the nesting birds will be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Smoke from prescribed burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could potentially cause an active nest to fail or individuals to avoid the area temporarily.

Intermediate/Uneven-aged Treatments

LaVA proposes up to 165,000 acres in intermediate treatments. These treatments would not revert stands to a re-initiation stage. They may, however, remove the large trees from a stand to open up the understory to growth, or remove clumps of trees, creating an uneven aged stand, or a variety of other options.

Intermediate treatments, depending on method used, may be beneficial to purple martin and their habitat. They could improve the quality of stands through thinning operations leading to larger nesting trees.

Intermediate treatments, as with stand-initiation treatments, are planned to take place primarily in areas of heavy beetle kill. These areas are not known to be used by purple martin.

Noise from machinery and vehicles has the possibility of affecting purple martin with this treatment type as well. Should treatment occur near an active nest, there is a chance that the nesting birds will be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Smoke from prescribed burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could potentially cause an active nest to fail or individuals to avoid the area temporarily.

Other Treatments

LaVA proposes up to 100,000 acres of 'other' treatment types. This could be shrub removal, conifer encroachment, jackpot burning, or various other treatments related to the understory. This type of treatment is more likely to occur in purple martin habitat. Included in this treatment category is coppice cuts, which will lead to regeneration of aspen stands through clear-cut treatments of this species.

Coppice cuts in large aspen will affect purple martin habitat through direct removal of potential nesting and foraging habitat.

Potential direct effects to purple martin through understory treatments are unlikely. Smoke from brush burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could cause an active nest to fail or individuals to avoid the area temporarily.

Noise from machinery and vehicles brings with it the possibility of affecting goshawks in these treatment types as well. Should treatment occur near an active nest, there is a high probability that the nesting birds will be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to

those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments will not reduce purple martin habitat as aspen is not a focus in these projects.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Studies on the effects of roads on purple martin are largely non-existent. However, Hutto (1993) found many passerine species to be affected by the presence of roads. Still, the current road network may be reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

Some habitat will remain across the Forest for purple martin based on the following:

- Purple martin are only known to have occurred in the Sierra Madre Range. There are no records of the species in the Snowy Range.
- This project impacts some habitat, reduces some habitat quality, regenerates some areas, and has the potential to improve some habitat in the long-term where aspen stands are released from pine encroachment.
- Forest Plan guideline to consult Partners-in-Flight Conservation Plans (p. 1-40) for additional guidance was accomplished. Purple martin is not listed as a priority species in Wyoming.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Olive-Sided Flycatcher – Sensitive Species

Existing Condition

Existing Conditions (from USDA 2003, App. I): *The species is associated with older spruce-fir forest with abundant snags that are used as a perch for flycatching. Olive-sided flycatchers prefer edges and openings with scattered trees, where they perch on treetops, flying up to capture passing insects from the air. Populations increase following fire. Burned areas support high densities of these flycatchers compared to other sites, as do natural openings around ponds, beaver ponds, and windfall. Additional life history information is available in USDA (2003).*

The olive-sided flycatcher is a widespread breeding bird in spruce fir forests of Canada, Alaska, and the mountains of the western U.S. Breeding Bird Survey data indicate a population decline of 70% since 1966. The Olive-sided flycatcher is not a species of extreme concern in Wyoming, with a heritage ranking of S3/S4. The species winters in Central and South America. The cause of the decline in population is not known and may be related to effects on the wintering ground. However, Reed (1995) rated 74 bird species in the Great Basin for vulnerability to local extirpation and gave the Olive-sided flycatcher the highest vulnerability of any species, based on its specialized habitat and diet, its low population where it occurs, its susceptibility to cowbird parasitism, as well as its migratory habit.

Forestwide surveys have been completed for songbirds across the Forest since 2005. Methods were revised through 2007. Standardized sampling has occurred since 2008. Table 29 displays results since 2008. Population monitoring results are available on the RMBO website: http://rmbo.org/v3/avian/ExploretheData.aspx

Table 26. Olive-sided flycatcher observations across the Forest.

YEAR	# Observed	Total Survey Points
2008	13	377
2009	23	253
2010	8	329
2011	30	343
2012	11	390
2013	23	405
2014	3	383
2012	21	346
2013	23	405
2014	3	383
2015	21	346
2016	0	189

Fire suppression reduces forest openings. Salvage logging removes habitat that is highly productive for the species prey and is structurally suitable (many foraging perches in an open habitat). Snags are cut in forested areas along edges of units to reduce safety hazard to loggers, reducing perches adjacent to created openings. Lack of burned areas in spruce-fir would remove the pulses in population that historically resulted from the high density and productivity following burns. However, whether the edge created by logging is used in a similar way to edges along bogs, meadows, and other natural openings is not known. A study in Oregon showed higher nesting success in post-fire than in post-logging habitat.

The response of olive-sided flycatchers to the beetle outbreak is explained in detail in Giezentanner (2008). That information is not repeated in this report but is summarized. In summary, pure stands of lodgepole provide minimal habitat for these flycatchers, so changes due to the beetle outbreak will be very small. Over twenty years, the pine beetle outbreak can improve flycatcher habitat where groups of dead trees fall to create gaps of 2.5 to 7 acres, especially those within stands or along the edges of live conifers (spruce-fir). The related key to providing olive-sided flycatcher habitat is small openings within standing forest structure. For the following 60 years, habitat quality will decline in both pure lodgepole and mixed conifer stands as forest edges are lost to lodgepole regeneration and growth.

In the long term 100 years and beyond following disturbance, habitat conditions will be slightly better than conditions that existed before the beetle outbreak. Pure lodgepole stands will provide little habitat except where gaps might be created. In mixed conifer stands, quality olive-sided flycatcher habitat will exist where canopy gaps have been created through stand senescence.

No Action Alternative

Direct and Indirect Effects

The insect and disease outbreak has affected mainly lodgepole pine, and to a much lesser degree spruce/fir forest types. For olive-sided flycatchers, a species with preferences leaning toward edge

habitat, mainly in spruce/fir forest types, current conditions are relatively favorable in areas where openings have been made in mature spruce/fir stands through forest succession.

The main natural factor influencing wildlife habitat is the insect/disease outbreak. Under the no action alternative, there are few impacts to wildlife, as no human-influenced vegetation management activity would occur. Lodgepole stands with high mortality most often exist as unsuitable habitat for several decades. Canopy cover and conifer tree seed production have declined substantially in the short term.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to wildlife habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments will not reduce olive-sided flycatcher habitat, as the dead lodgepole pine stands proposed for treatment are not currently habitat.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Hutto (1993) found many passerine species to be affected by the presence of roads. It is possible the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Modified Proposed Action

LaVA potential effects to species will vary from one analysis unit (AU) to the next dependent on a variety of factors (i.e. how much of the AU is in wilderness or other excluded area, how much has been treated in previous projects, etc). In table 30 and 31 below is an analysis of current olive-sided flycatcher habitat estimates within the two mountain ranges included in analysis.

Table 27. Estimated olive-sided flycatcher habitat and treatment opportunity acres in analysis units in the Sierra Madre Range by AU.

Analysis Unit	Total Acres	Acres available for SISS	Acres available for green tree	Acres available for intermediate treatment	Estimated Acres Current Habitat	Total Estimated Habitat in Mountain Range
Jack Savery	79,138	29,734	31,460	30,733	2,702	42,396
Sandy Battle	94,484	27,044	32,765	13,820	25,905	
Battle Pass	49,436	13,639	15,371	12,614	3,737	
Green Hog	65,940	12,347	15,454	12,139	6,318	
Big Blackhall	73,222	19,895	15,674	14,321	3,734	

Table 31. Estimated olive-sided flycatcher habitat and treatment opportunity acres in analysis units in the Snowy Range by AU.

Analysis Unit	Total Acres	Acres Available for SISS	Acres available green tree	Acres intermediate treatment	Estimated Acres Current Habitat	Total Estimated Habitat in Mountain Range
Pelton Platte	49,297	5,802	6,439	4,242	1,993	17,380
Fox Wood	85,609	35,130	34,077	18,342	1,681	
Owen Sheep	28,798	28,798	6,138	4,186	634	
French Douglas	66,086	17,322	23,941	11,080	370	
West French	69,697	18,296	25,576	14,790	2,946	
North Corner	45,106	15,723	10,550	15,095	961	
Rock Morgan	62,487	14,059	19,459	16,580	743	
Cedar Brush	60,899	10,725	22,852	14,327	3,510	
Bow Kettle	64,493	14,026	23,692	14,471	4,542	

Table 28. Potential effects to olive-sided flycatcher habitat through treatment, by AU

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	Medium	Medium	Low	Low	High	Medium
Big Blackhall	Low	Medium	Medium	Low	High	Medium
BowKettle	Low	Low	Low	Low	High	Low
CedarBrush	Low	Low	Low	Medium	High	Low
FoxWood	Medium	Low	Low	Linkage Medium	Low	Low
FrenchDouglas	Low	Medium	Low	Medium	Low	Low
GreenHog	Medium	Medium	Low	Low	High	Medium
JackSavery	Low	Low	Low	Low	High	Low
NorthCorner	Low	Medium	Low	Medium	Low	Low
OwenSheep	Low	Low	Low	Na	Medium	Low
PeltonPlatte	Medium	High	Low	Linkage Medium	High	Medium
RockMorgan	Low	High	Low	Medium	Medium	Medium
SandyBattle	High	Medium	Low	Na	High	High
WestFrench	Medium	Low	Low	Medium	Medium	Low

Stand initiation treatments (SISS)

The LaVA project proposes stand-initiating treatments be applied to up to 95,000 acres over the life of the project. The intention is to primarily treat stands which have been killed during the MPB epidemic.

The option is available to apply stand-initiating treatments to live stands that have reached 95% or higher CMAI. Highest estimates of these potential treatments indicate between 4,957 acres and 82,866 acres are available for these treatments.

For the purpose of this analysis, I will assume “worst-case” scenario for the olive-sided flycatcher. This highly unlikely scenario implies that stand-initiating treatments will be applied to 82,866 acres of green trees, leaving less than 13,000 acres of this type of treatment in dead, dying, and diseased stands.

After 95,000 acres are treated between the Snowy Range and Sierra Madre Range, assuming 82,866 acres were green lodgepole pine and/or spurce/fir, habitat could be improved through the creation of new openings for this edge-habitat specialist.

With timber harvest comes noisy machinery. Should treatment occur near an active nest, there is a high probability that the nesting birds will be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Smoke from prescribed burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could potentially cause an active nest to fail or individuals to avoid the area temporarily.

Intermediate/Uneven-aged Treatments

LaVA proposes up to 165,000 acres in intermediate treatments. These treatments would not revert stands to a re-initiation stage. They may, however, remove the large trees from a stand to open up the understory to growth, or remove clumps of trees, creating an uneven aged stand, or a variety of other options.

Intermediate treatments, depending on method used, may be beneficial to olive-sided flycatchers and their habitat. They could improve the quality of stands through thinning operations or group harvest creating openings.

Intermediate treatments, as with stand-initiation treatments, are planned to take place primarily in areas of heavy beetle kill. These areas are of little importance to the olive-sided flycatcher.

Noise from machinery and vehicles has the possibility of affecting olive-sided flycatchers with this treatment type as well. Should treatment occur near an active nest, there is a chance that the nesting birds will be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Smoke from prescribed burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could potentially cause an active nest to fail or individuals to avoid the area temporarily.

Other Treatments

LaVA proposes up to 100,000 acres of 'other' treatment types. This could be shrub removal, conifer encroachment, jackpot burning, or various other treatments related to the understory. It is possible that a shrub removal/fuels reduction or other project may occur within or near olive-sided flycatcher habitat.

Potential direct effects to olive-sided flycatchers through understory treatments are unlikely. Smoke from brush burns as well as potential for prescribed fire to creep out of the understory and up nest trees are both possibilities. Either of these could cause an active nest to fail or individuals to avoid the area temporarily.

Noise from machinery and vehicles brings with it the possibility of affecting olive-sided flycatchers in these treatment types as well. Should treatment occur near an active nest, there is a high probability that the nesting birds will be disturbed and even a chance they will desert the nest, losing their chance at reproduction that year.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These projects are unlikely to affect olive-sided flycatcher habitat, as they are directed toward harvest of largely dead stands. These areas are not habitat for the olive-sided flycatcher.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Hutto (1993) found many passerine species to be affected by the presence of roads. The current road network may be reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

Some habitat will remain across the Forest for olive-sided flycatchers based on the following:

- This project impacts some habitat, reduces some habitat quality, regenerates some areas, and has the potential to improve some habitat in the short-term where new openings are created in stands.
- Forest Plan guideline to consult Partners-in-Flight Conservation Plans (p. 1-40) for additional guidance was accomplished. Olive-sided flycatcher is listed as a level II priority species in Wyoming.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Bighorn Sheep – Sensitive Species

Existing Conditions

From USDA (2003): *Rocky Mountain bighorn sheep (Ovis canadensis) are currently found in all western states and provinces with historical records, from New Mexico to British Columbia. However, 5 northern races or subspecies of bighorn sheep (O. c. canadensis, O. c. californiana, O. c. auduboni) were extirpated from Arizona, New Mexico, Nebraska, Nevada, North Dakota, Oregon, South Dakota, Utah, and Washington (Toweill and Geist 1999)] (Ghormley 2010). Two of these populations are known to be in the SR and SMR of Medicine Bow National Forest.*

The states of California and Oregon lost an estimated 110 populations (McQuivey 1978, Wehausen et al. 1987). Populations in other western states and provinces of the United States and Canada probably declined to fewer than 5,000 individuals (Toweill and Geist 1999). The current distribution of Rocky Mountain bighorn sheep is primarily patchy and fragmented throughout much of their historical range.

In 1999, the total numbers of all bighorn sheep (Rocky Mountain and desert subspecies) in the contiguous United States were estimated at approximately 49,900 (Toweill and Geist 1999). Most extant populations of bighorn sheep in the Intermountain West consist of less than 100 individuals occurring in a fragmented distribution across the landscape (Singer et al. 2000a). Many of these herds are considered vulnerable to extirpation because of their small numbers and the lack of connectivity between herds (Wehausen 1999 and others in Beecham et al. 2007). Due to potential disease concerns, however, connectivity may currently not be desirable in all locations (CAST Commentary 2008).

Bighorn sheep numbers declined dramatically with the settling of the west and are currently estimated at less than 10 percent of historic numbers; however, they are still considered somewhat secure throughout much of their range (NatureServe 2003). Bighorn sheep populations in Colorado, Wyoming, and South Dakota are classified as secure (NatureServe 2003). Beecham et al. (2007), however, argue that these classifications may be overly-optimistic because they fail to recognize the critical issues involved with small herd sizes, the long history of and continued potential for disease epizootics, increasing levels of habitat fragmentation, and herd/genetic isolation.

Bighorn sheep are characterized by low reproductive rates, long life spans, and populations adapted to live near carrying capacity in relatively stable environments (Geist 1971). Bighorn sheep are a sexually dimorphic species with ewes that may weigh 190 pounds and rams may weigh greater than 300 pounds. Large-horned, older rams do much of the breeding, though younger rams will breed opportunistically (Hogg and Forbes 1997). Rams may breed several ewes; however, they are not territorial nor do they form harems, but rather are serial polygynists. Ewes generally first breed at 2.5 years and give birth to one lamb after a gestation period of 180 days (Lawson and Johnson 1983). In populations with high-quality forage, ewes may breed at 1.5 years and give birth at the age of two. Although twins have been documented in both wild and captive bighorn sheep it occurs infrequently (Eccles and Shackleton 1979).

Bighorn sheep are social animals that live in groups most of the year. Ewe groups (comprised of adult ewes, yearling ewes, lambs, and young rams) generally are larger than ram groups especially during late spring and early summer when nursery bands may contain 25-100 animals (Lange 1978, NMDGF files). Mature rams generally remain solitary or in bachelor groups except during the pre-rut and rut periods (November- January), when rams and ewes gather on the same range.

Bighorn sheep eat a wide variety of plants and their diets vary seasonally and throughout their geographic range (Todd 1975, Cooperrider and Hansen 1982, Johnson 1980, Rominger et al. 1988). Succulent vegetation in summer and snow and ice in winter help bighorns to survive for long periods without freestanding water. Forbs generally dominate the diet, followed by grasses, and lastly browse (Krausman and Shackleton 2000). However, some low-elevation Rocky Mountain bighorn sheep populations have diets dominated by the leaves of browse species, particularly true mountain-mahogany (Rominger et al. 1988). Bighorn sheep also use mineral licks, especially during summer when green, potassium-rich forage is consumed (Weeks and Kirkpatrick 1976).

Unlike other ungulates in which young disperse to new areas, bighorn sheep pass knowledge of home ranges and migration routes from one generation to the next. Therefore, bighorn sheep do not typically re-colonize ranges where they have been extirpated. Translocations are generally required to establish new populations (Singer and Gudorf 1999). The minimum size

for a population to be considered viable and self-sustaining by some authorities is 100, although several hundred are recommended to help maintain a high level of genetic diversity (Soule 1980, Soule and Simberloff 1986, Berger 1990, Goodson 1994, Krausman et al. 1996, Wehausen 1999)] (Ghormley 2010).

Habitat use in bighorn sheep is similar in most areas of their range. They are a steep mountain, high elevation species that prefers long sight lines with open escape routes. This means they tend to remain at high elevations, where rock, grass and short forbs dominate the landscape. They will often move to cliffsides inaccessible to other species to rest.

The species will sometimes move to slightly lower elevations during winter, where taller brush may be found for forage, or they may remain and eat dormant grasses under the snow and lichen off of windswept rocky patches. The species may be found practicing geophagia (eating soil) at multiple times of year. It is postulated that this practice is common due to a deficiency of certain minerals in the diet of the species, such as magnesium (Mg), sodium (Na), selenium (Se), and calcium (Ca). Summer forage also produces an excess of potassium (K) in their diet, and geophagia is thought to help supplement Na and Se during this time of excess to help "balance the scales" (Mincher *et al* 2007, Ghormley 2010).

There are two herds within the AA (USDA 2003):

*The **Douglas Creek** herd (in the SE Medicine Bow Mountains) occupies the rocky area and canyons that lie in and north of the N. Platte Wilderness. In summer, bighorns may be seen at the top of the Medicine Bow range, along Highway 130. Both rams and ewes have been seen in this area, which is probably part of the historic summer range for the species. The recent lack of large burns has left dense forest that reduces connectivity between this highelevation summer range and the lower wintering grounds. There are eight grazing allotments in the Medicine Bow range, running from the tundra (where bighorns have been seen) to the northeast. The high-elevation allotments are currently vacant (though recent queries have been made about use for sheep.) The other allotments on the Medicine Bow Range are either vacant or used by cattle, but there is no restriction on use by domestic sheep. Use of these allotments as a grass bank for sheep has been discussed.*

*The **Encampment River** herd has not flourished, though the reason for this is not clear. Though the herd's summer range overlaps several active grazing allotments occupied by sheep and Chlamydia has been found in the herd (Loose 2002), (Cook, Irwin Larry L et al. 1998). Pasteurella haemolytica has not been documented. However, the overall condition in the herd is poor; there is evidence that poor quality forage may be a contributing factor (Loose 2002), (Cook, Irwin Larry L et al. 1998). The Wyoming Interagency Bighorn Working Group ranks this herd as lowest priority (of 3 classes) for investment in habitat improvement.*

Historically, primary threats to the species include a wide variety of diseases, some of which come from domestic sheep (Geist 1971).

Fire suppression has led to a reduction of connectivity in habitat through conifer encroachment on the grassy areas the species uses to forage as well as migratory routes linking summer and winter ranges (USDA 2003).

No Action Alternative

Direct and Indirect Effects

The insect and disease outbreak has affected mainly lodgepole pine, and to a much lesser degree spruce/fir forest types. For bighorn sheep the affected areas are largely not important habitat. Most existing habitat within the Snowy Range and Sierra Madre is of moderate to poor quality.

Conifer encroachment will continue under the NAA, leading to continued degradation of habitat across the species' range in Medicine Bow National Forest.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to wildlife habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments will not reduce bighorn sheep habitat, as the dead lodgepole pine stands proposed for treatment are not habitat for the species.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Bighorn sheep are commonly known to occupy habitat beside even busy highways. It is possible the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Modified Proposed Action

LaVA potential effects to species will vary from one analysis unit (AU) to the next dependent on a variety of factors (i.e. how much of the AU is in wilderness or other excluded area, how much has been treated in previous projects, etc). In table 33 and 34 below is an analysis of current olive-sided flycatcher habitat estimates within the two mountain ranges included in analysis.

Table 29. Habitat and treatment opportunity acres in analysis units in the Sierra Madre Range.

Analysis Unit	Jack Savery	Sandy Battle	Battle Pass	Green Hog	Big Blackhall

Total Acres	Acres available for SISS	Acres available for green tree	Acres available for intermediate treatment	Estimated Acres Current Habitat	Total Estimated Habitat in Mountain Range
79,138	29,734	31,460	30,733	14,624	111,483
94,484	27,044	32,765	13,820	3,072	
49,436	13,639	15,371	12,614	42,266	
65,940	12,347	15,454	12,139	45,322	
73,222	19,895	15,674	14,321	6,682	

Table 30. Habitat and treatment opportunity acres in analysis units in the Snowy Range.

Analysis Unit	Total Acres	Acres Available for SISS
Pelton Platte	49,297	5,802
Fox Wood	85,609	35,130
Owen Sheep	28,798	28,798
French Douglas	66,086	17,322
West French	69,697	18,296
North Corner	45,106	15,723
Rock Morgan	62,487	14,059
Cedar Brush	60,899	10,725
Bow Kettle	64,493	14,026

Acres available green tree	Acres intermediate treatment	Estimated Acres Current Habitat	Total Estimated Habitat in Mountain Range
6,439	4,242	13,025	49,684
34,077	18,342	0	
6,138	4,186	0	
23,941	11,080	2,535	
25,576	14,790	30,119	
10,550	15,095	3,095	
19,459	16,580	0	
22,852	14,327	910	
23,692	14,471	0	

Table 31. Potential effects to bighorn sheep habitat, by AU.

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	High	Medium	Low	Low	Medium	Medium
Big Blackhall	Low	Medium	Medium	Low	High	Medium
BowKettle	None	Low	Low	Low	-	None
CedarBrush	Low	Low	Low	Medium	High	Low
FoxWood	None	Low	Low	Linkage Medium	-	None
FrenchDouglas	Low	Medium	Low	Medium	Low	Low
GreenHog	High	Medium	Low	Low	High	Medium
JackSavery	Low	Low	Low	Low	Low	Low
NorthCorner	Low	Medium	Low	Medium	High	Low

OwenSheep	None	Low	Low	Na	-	None
PeltonPlatte	High	High	Low	Linkage Medium	High	High
RockMorgan	Low	High	Low	Medium	Medium	Medium
SandyBattle	Low	Medium	Low	Na	Medium	Medium
WestFrench	Medium	Low	Low	Medium	High	Medium

Stand initiation treatments (SISS)

The LaVA project proposes stand-initiating treatments be applied to up to 95,000 acres over the life of the project. The intention is to primarily treat stands which have been killed during the MPB epidemic.

The option is available to apply stand-initiating treatments to live stands that have reached 95% or higher CMAI. Highest estimates of these potential treatments indicate between 4,957 acres and 82,866 acres are available for these treatments.

After 95,000 acres are treated between the Snowy Range and Sierra Madre Range, assuming 82,866 acres were green lodgepole pine and/or spurce/fir, habitat would likely be improved through the reduction in tree cover, if applied along areas adjacent to current habitat for bighorn sheep.

With timber harvest comes noisy machinery. There is a chance sheep may be displaced temporarily during harvest operations; though the species does not tend to avoid noisy roads, so chances of displacement are minimal.

Smoke from prescribed burns as well as potential for prescribed fire displace individuals is possible.

Intermediate/Uneven-aged Treatments

LaVA proposes up to 165,000 acres in intermediate treatments. These treatments would not revert stands to a re-initiation stage. They may, however, remove the large trees from a stand to open up the understory to growth, or remove clumps of trees, creating an uneven aged stand, or a variety of other options.

Intermediate treatments likely will not affect bighorn sheep habitat, as these treatments will leave the stands largely intact.

With timber harvest comes noisy machinery. There is a chance sheep may be displaced temporarily during harvest operations; though the species does not tend to avoid noisy roads, so chances of displacement are minimal.

Smoke from prescribed burns as well as potential for prescribed fire to displace individuals is possible.

Other Treatments

LaVA proposes up to 100,000 acres of 'other' treatment types. This could be shrub removal, conifer encroachment, jackpot burning, or various other treatments related to the understory. It is possible that a shrub removal/fuels reduction or other project may occur within or near bighorn sheep habitat.

Potential direct effects to bighorn sheep through understory treatments are unlikely. Smoke from brush burns as well as potential for prescribed fire to displace individuals. Either of these could cause individuals to avoid the area temporarily.

Noise from machinery and vehicles brings with it the possibility of affecting sheep. Individuals may be displaced temporarily during harvest operations; though the species does not tend to avoid noisy roads, so chances of displacement are minimal.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Bighorn sheep are known to occur on and near roads with varying levels of traffic. The current road network may be reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

Some habitat will remain across the Forest for bighorn sheep based on the following:

- This project impacts some habitat, reduces some habitat quality temporarily, regenerates some areas, and has the potential to improve some habitat in the long-term where new openings are created in stands.
- Where treatments occur adjacent to existing bighorn sheep habitat, suitable habitat will improve in quality.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Hoary Bat – Sensitive Species

Existing Conditions

Hoary bats occur throughout Region 2 during the summer season. They are one of the most widespread bats in North America but are solitary and considered rare by some; however, Griscom et al. (2012) found them to be the third most common bat in their surveys. There is geographic segregation with males found in the western U.S.

They have day and night roosts primarily among foliage in deciduous trees at the edge of clearings. Roosting trees tend to be the same height as the canopy (Willis and Brigham 2005) instead of standing taller or shorter than average. They forage in a variety of open habitats; so, this habitat is not limited.

Summer distribution results indicate that flowing or open water and presence of cliffs and rock formations are important predictors of their distribution. Wyoming Natural Diversity Database (WyNDD) developed habitat models based on these characteristics.

There is evidence that cottonwood riparian corridors may be declining due to western land and water management practices. To the extent that this is true, habitat for hoary bats may be decreasing. However, the response of riparian corridors to management varies by locality and there is little evidence for a consistent region-wide trend. Riparian corridors in general are sensitive to a variety of land and water management practices, including damming of rivers, livestock grazing, farming, and urban development. Of the three long-distance migrants, hoary bats are most often killed by wind turbines and as a result are of conservation concern (Griscom et al. 2012).

No Action Alternative

Direct and Indirect Effects

The insect and disease outbreak has affected mainly lodgepole pine, and to a much lesser degree spruce/fir forest types. For hoary bats, who roost in the foliage of deciduous trees, the disease outbreak does not change habitat.

The main natural factor influencing wildlife habitat is the insect/disease outbreak. Under the no action alternative, there are few impacts to wildlife, as no human-influenced vegetation management activity would occur. Lodgepole stands with high mortality most often exist as unsuitable habitat for several decades. Canopy cover and conifer tree seed production have declined substantially in the short term.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to wildlife habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments will not affect hoary bat habitat, as the dead lodgepole pine stands proposed for treatment are not currently habitat.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Bats have been found to use linear features such as roads as flight paths (Chidel 2002, Hein et al. 2008). Even so, it is possible the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known major utility proposals affecting the project area.

Modified Proposed Action

LaVA potential effects to species will vary from one analysis unit (AU) to the next dependent on a variety of factors (i.e. how much of the AU is in wilderness or other excluded area, how much has been treated in

previous projects, etc). In table 36 and 37 below is an analysis of current hoary bat habitat estimates within the two mountain ranges included in analysis.

Table 32. Estimated hoary bat habitat and treatment opportunity acres in analysis units in the Sierra Madre Range by AU.

Analysis Unit	Total Acres	Acres available for SISS	Acres available for green tree	Acres intermediate treatment	Estimated Acres Current Habitat
Jack Savery	79,138	29,734	31,460	30,733	2,702
Sandy Battle	94,484	27,044	32,765	13,820	25,905
Battle Pass	49,436	13,639	15,371	12,614	3,737
Green Hog	65,940	12,347	15,454	12,139	6,318
Big Blackhall	73,222	19,895	15,674	14,321	3,734

Total Estimated Habitat in Mountain Range
42,396

Table 33. Estimated hoary bat habitat and treatment opportunity acres in analysis units in the Snowy Range by AU.

Analysis Unit	Total Acres	Acres Available for SISS	Acres available green tree	Acres intermediate treatment	Estimated Acres Current Habitat
Pelton Platte	49,297	5,802	6,439	4,242	1,849
Fox Wood	85,609	35,130	34,077	18,342	1,681
Owen Sheep	28,798	28,798	6,138	4,186	634
French Douglas	66,086	17,322	23,941	11,080	370
West French	69,697	18,296	25,576	14,790	2,927
North Corner	45,106	15,723	10,550	15,095	961
Rock Morgan	62,487	14,059	19,459	16,580	743
Cedar Brush	60,899	10,725	22,852	14,327	3,510
Bow Kettle	64,493	14,026	23,692	14,471	4,542

Total Estimated Habitat in Mountain Range	17,217

Table 34. Potential effects to hoary bat habitat through treatments, by AU.

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	Low	Medium	Low	Low	High	Low
Big Blackhall	Low	Medium	Medium	Low	High	Medium
BowKettle	Low	Low	Low	Low	High	Low
CedarBrush	Low	Low	Low	Medium	High	Low
FoxWood	Medium	Low	Low	Linkage Medium	Low	Low
FrenchDouglas	Low	Medium	Low	Medium	Low	Low
GreenHog	Medium	Medium	Low	Low	High	Medium
JackSavery	Low	Low	Low	Low	High	Low
NorthCorner	Low	Medium	Low	Medium	Low	Low
OwenSheep	Low	Low	Low	Na	Medium	Low
PeltonPlatte	Medium	High	Low	Linkage Medium	High	Medium
RockMorgan	Low	High	Low	Medium	Medium	Medium

SandyBattle	High	Medium	Low	Na	High	High
WestFrench	Medium	Low	Low	Medium	Medium	Low

Stand initiation treatments (SISS)

The LaVA project proposes stand-initiating treatments be applied to up to 95,000 acres over the life of the project. The intention is to primarily treat stands which have been killed during the MPB epidemic.

The option is available to apply stand-initiating treatments to live stands that have reached 95% or higher CMAI. Highest estimates of these potential treatments indicate between 4,957 acres and 82,866 acres are available for these treatments.

After 95,000 acres are treated between the Snowy Range and Sierra Madre Range, assuming 82,866 acres were green lodgepole pine and/or spurce/fir, habitat would likely be largely unchanged for this species which prefers deciduous vegetation.

With timber harvest comes noisy machinery. There is a chance hoary bats may be displaced temporarily during harvest operations; though the species does not tend to avoid roads, so chances of displacement are minimal.

Smoke from prescribed burns as well as potential for prescribed fire to displace individuals is possible.

Intermediate/Uneven-aged Treatments

LaVA proposes up to 165,000 acres in intermediate treatments. These treatments would not revert stands to a re-initiation stage. They may, however, remove the large trees from a stand to open up the understory to growth, or remove clumps of trees, creating an uneven aged stand, or a variety of other options.

Intermediate treatments likely will not affect hoary bat habitat, as these treatments will leave the stands largely intact and will not be focused on the deciduous species the bat prefers.

With timber harvest comes noisy machinery. There is a chance bats may be displaced temporarily during harvest operations; though the species does not tend to avoid noisy roads, so chances of displacement are minimal.

Smoke from prescribed burns as well as potential for prescribed fire to displace individuals is possible.

Other Treatments

LaVA proposes up to 100,000 acres of ‘other’ treatment types. This could be shrub removal, conifer encroachment, jackpot burning, or various other treatments related to the understory. It is possible that a shrub removal/fuels reduction or other project may occur within or near hoary bat habitat.

Potential direct effects to hoary bats through understory treatments are unlikely. Smoke from brush burns as well as potential for prescribed fire to displace individuals. Either of these could cause individuals to avoid the area temporarily.

Noise from machinery and vehicles brings with it the possibility of affecting sheep. Individuals may be displaced temporarily during harvest operations; though the species does not tend to avoid roads, so chances of displacement are minimal.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

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The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Bats are known to occur near roads with varying levels of traffic. The current road network may be reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface

replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

Some habitat will remain across the Forest for hoary bats based on the following:

- This project impacts some habitat, reduces some habitat quality, regenerates some areas, and has the potential to improve some habitat in the long-term.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Boreal Owl – Sensitive Species

Existing Conditions

USDA (2003, App. I): *Boreal owls forage in mature and older spruce-fir most of the year. Prey is more available in this habitat in winter because the snow is less compacted, and in summer because there is less herbaceous cover than in regenerating openings. For this animal, so highly adapted to coping with winter cold, the limitation on the southern extent of its range may be availability of cool dense spruce for summer roosting.*

The high association with old growth spruce-fir is due to their dependence on this forest type as a secondary cavity nester and for year-round foraging. Herren (1994, in USDA 2003, App. I) found 77% of mating habitat locations in spruce-fir and the remainder in lodgepole stands with adequate forest structure. Boreal owls nest in cavities excavated by large woodpeckers such as northern flickers or in naturally created cavities. Boreal owls are limited by these circumstances because the principal excavating species, pileated woodpecker, does not occur on the Forest and large cavities are not

abundant in the southern Rockies. Nesting habitat structure consists of forests with a relatively high density of large trees ≥12 inches dbh, open understory, and a multilayered canopy. They avoid open areas, such as clearcuts and open meadows, except for occasional use of the edges and openings for foraging. Boreal owls prey primarily on small mammals, with redbacked voles making up the highest proportion of their diet. They will also take other small mammal species, birds, and some insects. Forest management that ensures mature and older forests will provide quality nesting, foraging, and roosting habitat.

Within the analysis area, mixed conifer and spruce/fir forest are the habitats capable of supporting boreal owl reproduction and year-round use. Large aspen trees can provide nesting sites but do not offer year-round foraging habitat due to snow crusting. Climax lodgepole pine stands are composed mostly of trees devoid of defects and internal decay in the upper tree bole. Second, these lodgepole stands are single canopy. Third, beetle-killed lodgepole stands have lost canopy cover, so only multi-storied lodgepole stands (mixed conifer) provide sufficient canopy cover for nesting and preventing snow crusting over prey habitat. Potential boreal owl habitat in the analysis area corresponds to stands characterized as lodgepole pine 4B and 4C and spruce-fir forest of structural stages 4A through 4C. There are >173,000 acres of habitat in the AA.

Mixed conifer and spruce/fir forests have the larger-diameter trees, bole defects and decay, coarse woody debris, tree species variety and canopy closure boreal owls favor for breeding, roosting and feeding sites. Hayward (1997) noted that “As secondary cavity nesters, borealsare intimately linked with the organisms and processes associated with formation of large tree cavities”.

Boreal owls are limited in the Forest by the abundance of large snags with cavities, by the amount of old forest with complex structures, and possibly by prey density. Snags are lost by firewood collection and in timber harvest. Lack of dead downed wood recruitment over time would reduce habitat suitability for the Boreal owl’s prey.

The widespread and extensive nature of the insect/disease outbreak in mature climax lodgepole stands precludes these stands from providing owl habitat, as reviewed by Hayward (2008). Hayward stated “This information along with an understanding of boreal owl nesting behavior suggests that boreal owls are likely to occupy subalpine forest watersheds if land units of approximately 2,000 ha support both large nest cavities and at least 20-25% of the area is occupied by living, mature and older forest.” Lodgepole forest regeneration could produce nesting habitat again in approximately 100 years.

In lodgepole stands with less spruce-fir, habitat for prey species and, therefore, prey abundance will decline over 5 years and stands will no longer be used for winter or summer foraging within 20 years (Hayward 2008). The widespread mortality in pure lodgepole stands have created these conditions across the analysis area. Previous prey abundance is not likely to return for 80-100 years after the disturbance. Still, this lodgepole change would be a small change to boreal owl foraging habitat since prey abundance is much higher in mature and older mixed conifer and spruce-fir. These changes are detailed in Hayward (2008).

Where individual lodgepole trees exist within mixed conifer and spruce-fir habitat, boreal owl habitat could improve in quality with beetle-kill. Important components of owl nesting, foraging and prey habitat, such as snags and coarse woody debris, were increased by this outbreak over several years. There could be an increased number of snags for nesting where natural cavities were created or were excavated by woodpeckers.

USDA (2003) provides: *Boreal owls are widespread at low density in boreal and subalpine forest across North America. A year-long resident, known to breed on the forest in the Laramie Range, Medicine Bow Range, and Sierra Madre. Nest boxes are occupied* [during the writing of this excerpt] *and reproduction has been confirmed. Garber et al. (1991, in USDA 2003, App. I) compiled a listing of 50 boreal owl observations that occurred in Wyoming from 1927-89 from records that included museum specimens, photographs, limited surveys, and incidental observations. Most observations were from Grand Teton National Park and southeastern Carbon County in the Snowy Range and Sierra Made Range.* No boreal owls have been documented during early morning monitoring transects conducted by RMBO. No boreal owls have been detected on BBS routes in Wyoming since 1966.

No Action Alternative

Direct and Indirect Effects

The insect/disease eliminated some low quality habitat in mixed conifer stands with a lower spruce-fir component. There is too much mortality in these stands to provide canopy cover over cavity nest sites or preclude snow crusting of prey habitat.

Boreal owl habitat will be maintained or improved in mixed conifer with a higher spruce-fir component and spruce-fir stands, where tree mortality is lower. Snags and coarse woody debris are increasing to HRV (Dillon et al. 2003), providing enhanced habitat for prey such as red-backed voles (Saab et al. 2014). Large snags have been created to provide potential cavity nesting sites.

Understory productivity will increase, advanced regeneration growth rate will increase, and subalpine fir trees will become a larger component of these stands (Dhar et al. 2016, Malcolm 2012). Subalpine fir trees have limbs that reach to the ground, providing habitat for prey rodents. In comparison, maturing lodgepole pine trees lose ground level limbs.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to lynx habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The pine beetle outbreak detailed earlier would have mixed results on boreal owl habitat depending on the existing habitat structure and level of tree mortality. Most mixed conifer and spruce-fir stands are still suitable habitat because of the retention of some live tree structure and accumulation of large snags and some woody debris.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce habitat if they occur in mixed conifer or spruce-fir stands with low or moderate tree mortality.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat (Forman et al 1997, Joslin and Youmans 1999). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Modified Proposed Action

Direct and Indirect Effects

There will be mixed effects of LAVA project implementation to boreal owls. Lodgepole pine stands with little or no understory do not provide quality boreal owl habitat. Most of these stands also have high tree mortality rates. These stands have not regenerated sufficiently to provide quality habitat (Kozlowski 2008). Vegetation management and associated temporary roads in these stands will not affect owl habitat.

Many prey animals have not declined significantly in response to insect/disease outbreaks (Stone 1995, Ivan and Seglund 2017). In fact, red-backed voles, the main prey animal, either did not respond to tree mortality or increased in stands with moderate tree mortality (Saab et al. 2014). In contrast, red-backed voles have responded negatively to salvage harvest (Sullivan et al. 2010). Several aspects of the project will reduce snag abundance and coarse woody debris, important habitat components for boreal owl nesting and prey habitat. So, the project can have some negative impacts to boreal owls.

Stand initiation treatments and associated temporary roads in lodgepole stands with sufficient understory trees (mixed conifer) provide owl habitat that will be impacted by vegetation management. The Forest's vegetation database suggests 4957 to 82,866 of the 95,000 acres of stand initiation treatment could be implemented because stands have reached CMAI. Field assessments in preparation for treatment will verify the final acreage of CMAI stands. These stands contain many live trees and some snags from the insect/disease outbreak. Many of these stands also still support red-backed vole prey. Stand initiation treatment and associated temporary roads will eliminate habitat in these stands where there is sufficient mixed conifer cover. Regenerated areas will provide foraging habitat in several decades as more complex structure returns. Forest Plan Standards to retain recruitment trees, snags, and coarse woody debris will provide important habitat characteristics and facilitate the return to suitable habitat.

Regeneration of habitat will be delayed for stands that occur in the Forest's WUI areas. There are no Forest Plan requirements to retain snags, large, live recruitment trees, or coarse woody debris in WUI

areas. Snags, large trees, and woody debris are important components of boreal owl habitat, providing structure in future mature stands. There are about 360,000 acres of potential treatment opportunities within these WUI areas. So, a substantial amount of owl habitat will have delayed development and lower habitat quality.

Intermediate and "other" treatments and associated temporary roads will reduce habitat quality. These stands have lower levels of tree mortality, higher levels of woody debris, and are often the spruce-fir stands that provide the best habitat (USDA 2003, App. I). Habitat quality will be lightly to moderately reduced in habitat outside of WUI areas in the short to mid-term, directly related to the level of tree, snag, and coarse woody debris removal. Where intermediate treatment methods are focused on small groups of trees not providing dense cover, regeneration of groups of live trees will promote habitat in the long term. Habitat quality will be greatly reduced in the Forest's WUI areas because there are no Forest Plan requirements to retain snags, large recruitment trees, or coarse woody debris in WUI areas. There are about 360,000 acres of potential treatment opportunities within these WUI areas. So, a substantial amount of owl habitat will have lower habitat quality and need years to decades to provide snags and coarse woody debris habitat components.

Where prescribed fire is the management tool, impacts will have some similarities and difference compared to mechanical treatment methods. Stand replacing fire will also eliminate habitat for several decades but there will be an abundance of snags and woody debris for improved future habitat quality. Buskirk (2002) addressing martens, suggests: Southern red-backed voles and red squirrels are important prey (of martens,) and, neither of these species would be positively affected by fire.

Some habitat qualities will be immediately enhanced where prescribed fire produces more of a mosaic within suitable habitat. The result will be an increase in snags and coarse woody debris. Magoun and Vernam (1986) found, while studying martens, high densities of CWD are recruited to the forest floor, succession favors high densities of herbaceous plants in early successional stages, and small mammals respond positively to early post-fire successional stages.

Temporary roads will be obliterated and returned to the land base within 3 years under all intermediate and "other" treatment methods. Obliteration methods are described in design criteria in the draft EIS. Regeneration to suitable habitat will occur in similar time frames to regeneration within stand initiation treatment areas.

Forest Plan standards to retain 15% lodgepole, 25% ponderosa pine, and 25% spruce-fir old growth by mountain range will ensure that additional boreal owl habitat is present on the landscape.

Noise associated with the machinery use, tools, and fire of treatment implementation can cause temporary disturbance to wildlife (see Forman et al.1997, Wisdom et al. 2005). Individuals could leave the immediate area during this brief period but could return after treatment is completed where habitat still exists. The temporary disturbances caused by these short-term activities are not expected to cause decreased reproductive success or survival across the population.

Impacts of the proposed actions to boreal owls by Accounting Unit (AU) can be estimated by several factors. For example, where the percentage of a species habitat in an AU is high or the acres in a No

Treatment Area in habitat is high, then impacts to species habitat are less. Areas within lynx habitat cannot exceed treatment parameters and related exemptions and exceptions identified in the Southern Rockies lynx amendment, so impacts to boreal owls would parallel the resulting condition of overlapping Lynx Analysis Units (LAU). Where tree mortality is higher, especially in single story lodgepole, vegetation management has little or no impact to habitat. On the other hand, where the percentage of an AU that is within WUI is high, the treatment impacts to habitat can be more pronounced because snags, large recruitment trees, and coarse woody debris do not have to be retained in treated areas. These habitat features are important to species that use old forest. Impacts of proposed actions are summarized in the table below.

Table 35. Impacts of proposed actions to boreal owls by accounting unit.

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	High	High	Low	Low	Medium	Medium
Big Blackhall	Medium	Medium	Medium	Low	Medium	Medium
BowKettle	High	Low	Low	Low	Medium	Low
CedarBrush	High	Low	Low	Medium	Medium	Low
FoxWood	Low	Low	Low	Linkage Medium	Low	Low
FrenchDouglas	Medium	Medium	Low	Medium	Medium	Medium
GreenHog	Medium	High	Low	Low	Medium	Medium
JackSavery	High	Low	Low	Low	Low	Low
NorthCorner	High	Medium	Low	Medium	Medium	Medium
OwenSheep	Low	Low	Low	Na	Low	Low
PeltonPlatte	Low	High	Low	Linkage Medium	High	Medium
RockMorgan	High	High	Low	Medium	Medium	Medium
SandyBattle	Low	Low	Low	Na	Low	Low
WestFrench	High	Low	Low	Medium	Medium	Low

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The pine beetle outbreak detailed earlier would have mixed results on boreal owl habitat depending on the existing habitat structure and level of tree mortality. Most mixed conifer and spruce-fir stands are still suitable habitat because of the retention of some live tree structure and accumulation of large snags and some woody debris.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments could reduce owl habitat if they occur in mixed conifer or spruce-fir stands with low or moderate tree mortality.

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Transportation System: Roads can have impacts to wildlife and habitat (Forman et al 1997, Joslin and Youmans 1999). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

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Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

Some habitat will remain across the Forest for boreal owls based on the following:

- This project impacts some habitat, reduces some habitat quality, and regenerates some areas not currently suitable habitat.
- Stands of designated old growth will be retained across the mountain ranges according to Forest Plan Standards (USDA 2003), maintaining some habitat.
- Some treatment will occur in designated roadless areas, reducing boreal owl habitat often unaffected by management actions.
- Snags, recruitment trees, and coarse woody debris may not be retained in WUI treatment areas, reducing boreal owl habitat.
- Forest Plan guideline to consult Partners-in-Flight Conservation Plans (p. 1-40) for additional guidance was accomplished. Boreal owl is a Level II priority species.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Pygmy Shrew – Sensitive Species

Existing Conditions

From USDA 2003, App. I: *Pygmy shrews are widespread across Canada and northern U.S. with an isolated population (subspecies S. hoyi montanus) in Colorado and SE Wyoming. The subspecies S. hoyi montanus is a Pleistocene relict, separated by hundreds of miles from the rest of the species in the northern U.S. and Canada. Its lack of dispersal ability, restriction to boreal habitat (especially edges of*

fen and fenlike wetlands in spruce/fir forest), and limited distribution (mountains in se Wyoming and central Colorado) make the species vulnerable. Little information is available on population or trends. One author suggested the population may be declining. Trap sites where pygmy shrews were found in 1969 (7 specimens) yielded none during intensive trapping in 1979-1980 (Clark and Stromberg 1987 in Welp et al. 2000). However, Beauvais in USDA (2004a) was unaware of any data with which to estimate population trends. Pygmy shrews have been recorded in the Centennial, Green Rock, June Creek areas of the Snowy Range and the Coon Creek area of the Sierra Madres (18 specimens). The species is small and inconspicuous and would be detected only by trapping.

Pygmy shrews are active beneath the snow all winter, feeding primarily on insects and carrion. Pygmy shrews feed on a variety of arthropods, worms, and insects. Feeding areas consist of interspersed wet and dry sites to assure an adequate prey base. As the smallest mammal in North America, pygmy shrews have high-energy demands per unit weight, and must consume considerable amounts of high-energy food to stay alive. (One estimate is over 1,500 spiders/day). Like all shrews, individuals need to hunt many hours a day to gather enough food to survive. In winter, insulation from adequate snow cover is necessary to buffer the extremes of cold found at high elevation. Pygmy shrews further conserve energy by resting in bulky nests. The shorter winter feeding forays may allow them to return while the nest is still warm from the last visit. They need access to enough foraging space beneath the snow to gather adequate food.

Pygmy shrews in Wyoming prefer sphagnum moss on edges of small ponds in spruce-fir forests, moist meadows, bogs, and other wet areas at high elevations, mostly above 9,000 feet. They nest in old, decaying logs and in the roots of tree stumps. Such habitat information as is available for pygmy shrew comes principally from 2 studies where capture site conditions are carefully described. Spencer and Pettus (1966) provide detailed information on vegetation, physical setting and invertebrate fauna where pygmy shrews were collected in Larimer County, Colorado, at an average elevation of 9650 feet. They suggest that Pygmy shrew requires both forest and wetland in close proximity and that, perhaps, these habitats need to be interspersed. Brown (1967) reports similar wetland/forest habitat conditions for pygmy shrews captured at 9620 feet elevation in Albany County, Wyoming, emphasizing that 6 pygmy shrews he trapped were found "only around the periphery of the bog [adjacent to spruce/fir] in an area dominated by a deep, spongy mat of sphagnum moss (p. 621)." Incidental characterizations of habitat provided by Brown (1966), DeMott and Lindsey (1975) and O'Doherty (2003) corroborate an association between pygmy shrews and wetland/forest edges, although 2 shrew specimens caught by DeMott and Lindsey were from habitats at least hundreds of feet away from conifer stands. While not conclusive, available evidence suggests forest/wetland edges are primary (key) habitat for pygmy shrews in the southern Rocky Mountains (Brown 1966, Brown 1967, DeMott and Lindsey 1975, Long 1972, Spencer and Pettus 1966) and this habitat complex may be essential. No published reports were located that indicated pygmy shrew may be affiliated with other habitat(s).

Several areas on the Forest are completely consistent with general habitat characteristics just described. The key macro-elements of habitat present on the Forest are: 1), an ecotone where wetlands and mature-or-older forest adjoin, 2), elevation above 9000 feet and 3), close proximity to water. According

to Long (1972), all 7 subspecies of pygmy shrews have usually been collected within 300 feet or so of water.

Insofar as vegetation is concerned, a number of plants and coarse woody debris (CWD) have been associated with pygmy shrew habitats. Engelmann spruce, subalpine fir and lodgepole pine comprise the major tree species in forests where *S. h. montanus* has been collected in Wyoming and Colorado (Brown 1966, Brown 1967, DeMott and Lindsey 1975, Spencer and Pettus 1966, Vaughan 1969). Several investigators have also noted plentiful coarse woody debris within forest sites where pygmy shrews have been captured (DeMott and Lindsey 1975, Long 1972, O'Doherty 2003). In addition to trees, Spencer and Pettus (1966), at their study site west of Fort Collins, Colorado, identified a number of plants they found in association with shrew capture sites. Given their assertion that pygmy shrews require both forest and wetlands, 5 plant genera identified in the Spencer and Pettus study may indicate *S. h. montanus* habitat when found with the above 3 trees (Long 1972). The 5 plants included by Long (1972) as indicators for *montanus* shrew habitat are sedge (*Carex* spp.), reedgrass (*Calamagrostis* spp.), willow (*Salix* spp.), sphagnum moss (*Sphagnum* spp.) and huckleberry (*Vaccinium* spp.). All 5 plant indicators are found in the analysis area.

Local populations of *S. h. montanus* may be vulnerable to extirpation across the subspecies' geographic range due to several characteristics of this shrew's ecology. Considering this subspecies may be relegated to primary habitats of fens, wet meadows, or other wetland areas located adjacent (generally within 300 ft.) to spruce/fir forests, this habitat complex probably is an uncommon occurrence on the landscape. Additionally, suitable wetland/forest habitats may be isolated within the montane landscape and are often limited in area extent as well. At the same time, wetland/forest habitat complexes are discontinuous one from another and are usually separated by habitats seemingly unsuitable for *S. h. montanus* to traverse. Coupled with the fact that suitable habitats are likely disjunct on the landscape is the reality that dispersal capabilities for this animal seem poor. The inability for pygmy shrews to disperse long distances likely increases the insularity of local population segments (Beauvais and McCumber 2006). Taken together, these characteristics indicate caution is essential when considering disruption effects or habitat modifications in or near pygmy shrew habitat.

Logging of subalpine forest creates sites that may be too dry for pygmy shrews (depending on the type of harvest and loss of canopy cover). Roads degrade habitat by replacing vegetation with packed road beds that may serve as movement barriers (Beauvais and McCumber). Livestock grazing can reduce the height and density of understory vegetation and compact soils, which can also reduce invertebrate abundance (Beauvais and McCumber).

Logging alters the amount, arrangement and structure of dead downed wood essential to the species. In their assessment of HRV on the Forest, Dillon et al. (2003), indicated that harvesting has created low levels of coarse woody debris that are beyond the range of HRV. They also indicated that USFS recommendations for coarse woody debris in harvest units (Graham et al. 1994) will still provide less coarse woody debris after several harvest rotations than would occur naturally after the same number of fires. Finally, the authors indicated that natural disturbances do not remove large pieces of wood from forests. The FEIS for the revised Forest Plan also indicated that logged sites have changed the amount, spatial distribution, temporal patterns, and size of downed wood (USDA 2003, p. D-82 – D-85).

USDA (2003) also indicated that the greater concern is not the immediate effects but the potential decline in the amount and size and the possible gap in production of downed wood over several decades.

Recreation resulting in compaction of snow, especially near wetlands, may be a threat. Alteration in the physical structure of snow that reduces its insulation and passage of O_2 and CO_2 would reduce habitat suitability for this species. The species would be most vulnerable to compaction effects where compaction is most likely to occur, in open forest or in wet areas adjacent to forest, rather than in denser forest.

There are approximately 36,000 acres of potential pygmy shrew habitat in the analysis area consisting of wet meadows, fens, slow streams and "bog"-margined ponds within 300 ft. of spruce-fir or mixed conifer forest at or above 9000 ft. Where small groups of beetle-killed lodgepole trees exist within this spruce-fir habitat, pygmy shrew habitat could improve in quality with the increase in coarse woody debris over time.

No Action Alternative

Direct and Indirect Effects

Varying levels of insects and pathogens and natural fire intervals play significant ecological roles in the life history of a pygmy shrew. It is likely that this Pleistocene-relict has persisted through other natural disturbances of the magnitude of the recent insect/disease beetle outbreak. The most important habitat characteristic that will result from this broadscale tree mortality is the abundance of down woody material in proximity to water sources. The tree mortality, defoliation, and the eventual decay and collapse of snags are processes that provide for this down woody material and pygmy shrew habitat for denning and foraging.

Prey abundance in suitable habitat could increase over time as a result of the beetle outbreak. Dillon et al. (2003) indicated that coarse woody debris, which depends on long periods of forest development, has been less common than the HRV in high elevation forests due to past logging. Coarse woody debris was not required to be left during harvest decades ago. Even coarse woody debris required to be retained in harvest units after the adoption of the 1985 Forest Plan was about 10% of the low range that occurs under natural conditions (USDA 2003, p. 3-148). Therefore, the dead and dying trees from the beetle outbreak have been restoring natural amounts of coarse woody debris over time. This will be a particular benefit during winter when pygmy shrews rely on the increased coarse woody debris for improved survival in a subnivian environment.

Understory productivity will increase, advanced regeneration growth rate will increase, and subalpine fir trees will become a larger component of these stands (Dhar et al. 2016, Malcolm 2012). Subalpine fir trees have limbs that reach to the ground, providing cover and retaining site moisture. In comparison, maturing lodgepole pine trees lose ground level limbs.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to lynx habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The insect/disease outbreak detailed earlier is expected to have little impact to pygmy shrews. So, impacted areas are still considered suitable habitat. Habitat quality in mixed conifer and spruce-fir will be retained or improved due to retention of live cover and accumulation of some woody debris.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. The Fox Creek area and Ryan Park projects in the Snowy Range will have little impact to pygmy shrews. Ryan Park project does not overlap with any habitat and the Fox Creek project might overlap with less than 200 acres of pygmy shrew habitat. These 200 acres of possible treatments could reduce shrew habitat if they occur in stands with low or moderate tree mortality.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat (Forman et al 1997, Joslin and Youmans 1999). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Few weeds occur in pygmy shrew habitat. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Modified Proposed Action

Direct and Indirect Effects

There will be mixed effects of LAVA project implementation to pygmy shrews. For any vegetation management, much of pygmy shrew will be avoided. There are several project design criteria to avoid direct ignition or heavy equipment in wetlands, wet meadows, riparian areas, or gallery forests. There are design criteria to avoid water influence zones and restrict treatment in wet soil areas to over the snow operations with at least 12 inches of snow covering these habitats. These measures will protect or avoid much pygmy shrew habitat.

Lodgepole pine stands with little or no understory do not provide pygmy shrew habitat. These stands are most often the drier forested sites away from wetlands. Most of these stands also have high tree mortality rates. Vegetation management and associated temporary roads in these stands will not affect pygmy shrew habitat.

Stand initiation treatments and associated temporary roads in lodgepole stands with sufficient understory trees (mixed conifer) provide pygmy shrew habitat that will be impacted by vegetation management. The Forest's vegetation database suggests 4957 to 82,866 of the 95,000 acres of stand initiation treatment could be implemented because stands have reached CMAI. Field assessments in preparation for treatment will verify the final acreage of CMAI stands. These stands contain many live

trees and some woody debris from the insect/disease outbreak. Some of these stands could be within 300 feet of wetland habitat. Stand initiation treatment and associated temporary roads will eliminate habitat in these stands where there is sufficient vegetation cover and woody debris to be suitable to shrews. Regenerated areas will provide habitat in several decades as more complex structure returns and sites retain moisture. Forest Plan Standards to retain recruitment trees, snags, and coarse woody debris will provide important habitat characteristics and facilitate the return to suitable habitat.

Regeneration of habitat will be delayed for stands that occur in the Forest's WUI areas. There are no Forest Plan requirements to retain snags, large, live recruitment trees, or coarse woody debris in WUI areas. Snags, large trees, and woody debris are important components of pygmy shrew habitat, retaining the moist microsites with cover that are necessary. There are about 360,000 acres of potential treatment opportunities within these WUI areas. Approximately one quarter of the pygmy shrew habitat overlaps with WUI areas. So, a substantial amount of shrew habitat could have delayed development and lower habitat quality.

Intermediate and "other" treatments and associated temporary roads will reduce habitat quality. These stands have lower levels of tree mortality, higher levels of woody debris, and are often the spruce-fir stands that provide the best habitat (USDA 2003, App. I). Habitat quality will be lightly to moderately reduced in habitat outside of WUI areas in the short to mid-term, directly related to the level of tree, snag, and coarse woody debris removal around wetland habitat. Where intermediate treatment methods are focused on small groups of trees not containing dense cover and woody debris, regeneration of groups of live trees will promote habitat in the long term. Habitat quality will be greatly reduced in the Forest's WUI areas because there are no Forest Plan requirements to retain snags, large recruitment trees, or coarse woody debris in WUI areas. There are about 360,000 acres of potential treatment opportunities within these WUI areas. Approximately one quarter of the pygmy shrew habitat overlaps with WUI areas. So, a substantial amount of shrew habitat will have lower habitat quality and need years to decades to provide moist microsites and coarse woody debris habitat components.

This subspecies of pygmy shrew exists as a relict population of isolated groups with very limited dispersal ability within a narrow range of primary habitat. These shrews are not likely to reoccupy widely separated relics of habitat where habitat is initially lost then habitat quality returns over time. However, treatment methods should occur within the edges of habitat due to design features and many wetlands are in close proximity. So, habitat temporarily lost can be reoccupied by pygmy shrews over time.

Where prescribed fire is the management tool, impacts will have some similarities and difference compared to mechanical treatment methods. Stand replacing fire will also eliminate habitat for several decades but there will be an abundance of snags and woody debris for improved future habitat quality.

Some habitat qualities will be immediately enhanced where prescribed fire produces more of a mosaic within suitable habitat. The result will be an increase in snags and coarse woody debris combined with a retention of cover to retain moist microsite characteristics.

Temporary roads will be obliterated and returned to the land base within 3 years under all intermediate and "other" treatment methods. Obliteration methods are described in design criteria in the draft EIS. Regeneration to suitable habitat will occur in similar time frames to regeneration within stand initiation treatment areas.

Forest Plan standards to retain 15% lodgepole, 25% ponderosa pine, and 25% spruce-fir old growth by mountain range will ensure that additional pygmy shrew habitat is present on the landscape.

Noise associated with the machinery use, tools, and fire of treatment implementation can cause temporary disturbance to wildlife (see Forman et al.1997, Wisdom et al. 2005). Individuals could leave the immediate area during this brief period but could return after treatment is completed where habitat still exists. The temporary disturbances caused by these short-term activities are not expected to cause decreased reproductive success or survival across the population.

Impacts of the proposed actions to pygmy shrews by Accounting Unit (AU) can be estimated by several factors. For example, where the percentage of a species habitat in an AU is high or the acres in a No Treatment Area in habitat is high, then impacts to species habitat are less. Areas within lynx habitat cannot exceed treatment parameters and related exemptions and exceptions identified in the Southern Rockies lynx amendment, so impacts to pygmy shrew would parallel the resulting condition of overlapping Lynx Analysis Units (LAU). Where tree mortality is higher, especially in single story lodgepole, vegetation management has little or no impact to habitat. On the other hand, where the percentage of an AU that is within WUI is high, the treatment impacts to habitat can be more pronounced because snags, large recruitment trees, and coarse woody debris do not have to be retained in treated areas. These habitat features are important to this species. Impacts of proposed actions are summarized in the table below.

Table 40. Impacts of proposed actions to pygmy shrews by accounting unit

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	Medium	Medium	Low	Low	Medium	Medium
Big Blackhall	Low	Medium	Medium	Low	High	Medium
BowKettle	Medium	Medium	Low	Low	Medium	Medium
CedarBrush	Medium	Medium	Low	Medium	Medium	Medium
FoxWood	Low	Low	Low	Linkage Medium	Low	High
FrenchDouglas	Medium	Low	Low	Medium	Low	Medium

GreenHog	Low	High	Low	Low	High	Medium
JackSavery	Low	Low	Low	Low	Medium	High
NorthCorner	Medium	Medium	Low	Medium	Medium	Medium
OwenSheep	Low	None	Low	Na	None	High
PeltonPlatte	Low	Low	Low	Linkage Medium	High	Medium
RockMorgan	Medium	Medium	Low	Medium	High	Medium
SandyBattle	None	Na	Low	Na	Na	No Impact
WestFrench	Low	Low	Low	Medium	Medium	Medium

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The insect/disease outbreak detailed earlier is expected to have little impact to pygmy shrews. So, impacted areas are still considered suitable habitat. Habitat quality in mixed conifer and spruce-fir will be retained or improved due to retention of live cover and accumulation of some woody debris.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. The Fox Creek area and Ryan Park projects in the Snowy Range will have little impact to pygmy shrews. Ryan Park project does not overlap with any habitat and the Fox Creek project might overlap with less than 200 acres of pygmy shrew habitat. These 200 acres of possible treatments could reduce shrew habitat if they occur in stands with low or moderate tree mortality.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat (Forman et al 1997, Joslin and Youmans 1999). So, it is likely the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Few weeds occur in pygmy shrew habitat. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

A “may adversely impact individuals, but not likely to result in a loss of viability on the Planning Area, nor cause a trend to federal listing or a loss of species viability rangewide” determination is made for pygmy shrew. Some habitat will remain across the Forest for pygmy shrews based on the following:

- This project impacts some habitat, reduces some habitat quality, and regenerates some areas not currently suitable habitat.
- Most treatments within habitat will be within the edges of habitat because of design criteria that protect wetlands, moist soils, and water influence zones.
- Stands of designated old growth will be retained across the mountain ranges according to Forest Plan Standards (USDA 2003), maintaining some habitat.

- Some treatment will occur in designated roadless areas, reducing some pygmy shrew habitat often unaffected by management actions.
- Snags, recruitment trees, and coarse woody debris may not be retained in WUI treatment areas, reducing pygmy shrew habitat.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Hudsonian Emerald – Sensitive Species

Existing Conditions

(from USDA 2003, App. I)
The Hudsonian emerald is widespread and abundant in the northern part of its range (boreal forest and muskeg of Canada), but far less common in Colorado, the southernmost part of its range. A single record of this dragonfly was reported in 1937, in a location given only as "Medicine Bow Mountains".

In surveys of dragonflies in the Snowy Range, other emeralds were found, but not the Hudsonian. The species could be present and undetected, because identification and capture are difficult. The larvae are cryptically-colored and are difficult to catch in the dense bog vegetation they inhabit. On the other hand, the species may not be present at all. The single record from 1937 is not very strong evidence of continuous occupation of habitat or past or present abundance. Habitat that is apparently suitable is present, so management will assume the presence of the species at least until surveys are conducted.

The larvae of the species live in bogs and fens and adults are found around "slow streams and bog-margined ponds". It was also found on deep, sedge-bordered lakes and ponds in the Yukon.

The main threat is degradation of its aquatic habitat (Packauskas 2005). *Alteration of habitat by removing trees around suitable ponds, grazing that removes perching or emergence vegetation, pesticide use, trampling, organic enrichment, siltation, or changes in winter temperature regimes could affect larval survival and abundance.*

Trampling by permitted livestock could directly kill larvae. Contamination of water (in suitable habitat, this would most likely come from livestock tramping of banks or erosion associated with sediment from roads or logging) reduces the quality of larval habitat. Snowmobile compaction over fens would allow deeper freezing of the boggy habitat and may adversely affect larval survival (USDA 2003, App. I).

No Action Alternative

Direct and Indirect Effects

The insect and disease outbreak has affected mainly lodgepole pine, and to a much lesser degree spruce/fir forest types. Hudsonian emeralds are a water-dependent species. The larvae live in bogs and fens, with adults found around slow streams and bog-margined ponds. Possible effects from the insect

and disease outbreak include crushing of individuals or larvae by falling trees and increases in ground and water temperature through enlargement of openings surrounding habitat.

The accumulation of woody debris and increase of subalpine fir could increase the probability of wild fires at certain time periods in the future. On the other hand, the return of aspen to many of these stands can partially counteract the fire threat from firs (Malcolm 2012). There is currently vigorous scientific debate about the influence of bark beetle killed trees to wild fires (Wells 2012). Moreover, the geographic extent and severity of wild fires is determined by many climatic factors, vegetation conditions, topography, and local weather conditions. It is difficult to predict wild fire impacts to wildlife habitat in the future.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. These treatments will not affect emerald habitat, as the dead lodgepole pine stands proposed for treatment are not currently habitat, and treatments must meet specific criteria to encroach on wet areas.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat. Presence of roads is unlikely to affect the presence of emeralds. Even so, it is possible the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known major utility proposals affecting the project area.

Modified Proposed Action

Direct and Indirect Effects

There will be mixed effects of LAVA project implementation to Hudsonian emeralds. For any vegetation management, much of Hudsonian emerald habitat will be avoided. There are several project design criteria to avoid direct ignition or heavy equipment in wetlands, wet meadows, riparian areas, or gallery forests. There are design criteria to avoid water influence zones and restrict treatment in wet soil areas to over the snow operations with at least 12 inches of snow covering these habitats. These measures will protect or avoid much emerald habitat.

Lodgepole pine stands with little or no understory do not provide emerald habitat. These stands are most often the drier forested sites away from wetlands. Most of these stands also have high tree mortality rates. Vegetation management and associated temporary roads in these stands will not affect emerald habitat.

Stand initiation treatments and associated temporary roads in lodgepole stands with sufficient understory trees (mixed conifer) may provide emerald habitat which could be impacted by vegetation management. The Forest's vegetation database suggests 4957 to 82,866 of the 95,000 acres of stand initiation treatment could be implemented because stands have reached CMAI. Field assessments in preparation for treatment will verify the final acreage of CMAI stands. These stands contain many live trees and some woody debris from the insect/disease outbreak. Some of these stands could be within 300 feet of wetland habitat. Stand initiation treatment and associated temporary roads will eliminate habitat in these stands where there is sufficient water cover for emeralds. Regenerated areas will provide habitat in several decades as more complex structure returns and sites retain moisture. Forest

Plan Standards to retain recruitment trees, snags, and coarse woody debris will provide important habitat characteristics and facilitate the return to suitable habitat.

Regeneration of habitat will be delayed for stands that occur in the Forest's WUI areas. There are no Forest Plan requirements to retain snags, large, live recruitment trees, or coarse woody debris in WUI areas. There are about 360,000 acres of potential treatment opportunities within these WUI areas. Approximately one quarter of the Hudsonian emerald habitat overlaps with WUI areas. So, a substantial amount of emerald habitat could have delayed development and lower habitat quality.

Intermediate and "other" treatments and associated temporary roads will reduce habitat quality. These stands have lower levels of tree mortality, higher levels of woody debris, and are often the spruce-fir stands that provide the best habitat (USDA 2003, App. I). Habitat quality will be lightly to moderately reduced in habitat outside of WUI areas in the short to mid-term, directly related to the level of tree, snag, and coarse woody debris removal around wetland habitat. Where intermediate treatment methods are focused on small groups of trees not containing dense cover and woody debris, regeneration of groups of live trees will promote habitat in the long term. Habitat quality will be greatly reduced in the Forest's WUI areas because there are no Forest Plan requirements to retain snags, large recruitment trees, or coarse woody debris in WUI areas. There are about 360,000 acres of potential treatment opportunities within these WUI areas. Approximately one quarter of the Hudsonian emerald habitat overlaps with WUI areas. So, a substantial amount of emerald habitat will have lower habitat quality and need years to decades to provide moist microsites and coarse woody debris habitat components.

This species of emerald is not definitively known to occur on the Medicine Bow National Forest.

Where prescribed fire is the management tool, impacts will have some similarities and difference compared to mechanical treatment methods. Stand replacing fire will also eliminate habitat for several decades but there will be an abundance of snags and woody debris for improved future habitat quality.

Some habitat qualities will be immediately enhanced where prescribed fire produces more of a mosaic within suitable habitat. The result will be an increase in snags and coarse woody debris combined with a retention of cover to retain moist microsite characteristics.

Temporary roads will be obliterated and returned to the land base within 3 years under all intermediate and "other" treatment methods. Obliteration methods are described in design criteria in the draft EIS. Regeneration to suitable habitat will occur in similar time frames to regeneration within stand initiation treatment areas.

Noise associated with the machinery use, tools, and fire of treatment implementation can cause temporary disturbance to wildlife (see Forman et al. 1997, Wisdom et al. 2005). Individuals could leave the immediate area during this brief period but could return after treatment is completed where habitat still exists. The temporary disturbances caused by these short-term activities are not expected to cause decreased reproductive success or survival across the population.

Impacts of the proposed actions to Hudsonian emeralds by Accounting Unit (AU) can be estimated by several factors. For example, where the percentage of a species habitat in an AU is high or the acres in a No Treatment Area in habitat is high, then impacts to species habitat are less. On the other hand, where the percentage of an AU that is within WUI is high, the treatment impacts to habitat can be more pronounced. Impacts of proposed actions are summarized in the table below.

Table 41. Potential impacts of proposed actions to Hudsonian emeralds by accounting unit

Accounting Unit	% Habitat in AU	% No Treatment Area in Habitat	% forested with >50% tree mortality	Quality of lynx LAU after treatment	% habitat outside WUI	Resulting Habitat Quality/Quantity
BattlePass	Medium	Medium	Low	Low	Medium	Medium
Big Blackhall	Low	Medium	Medium	Low	High	Medium
BowKettle	Medium	Medium	Low	Low	Medium	Medium
CedarBrush	Medium	Medium	Low	Medium	Medium	Medium
FoxWood	Low	Low	Low	Linkage Medium	Low	High
FrenchDouglas	Medium	Low	Low	Medium	Low	Medium
GreenHog	Low	High	Low	Low	High	Medium
JackSavery	Low	Low	Low	Low	Medium	High
NorthCorner	Medium	Medium	Low	Medium	Medium	Medium
OwenSheep	Low	None	Low	Na	None	High
PeltonPlatte	Low	Low	Low	Linkage Medium	High	Medium
RockMorgan	Medium	Medium	Low	Medium	High	Medium
SandyBattle	None	Na	Low	Na	Na	No Impact
WestFrench	Low	Low	Low	Medium	Medium	Medium

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses do not attempt to quantify the effects of past human actions by adding them on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The insect/disease outbreak detailed earlier is expected to have little impact to Hudsonian emeralds. So, impacted areas are still considered suitable habitat. Habitat quality in mixed conifer and spruce-fir will be retained or improved due to retention of live cover and accumulation of some woody debris.

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. The Fox Creek area and Ryan Park projects in the Snowy Range will have little impact to Hudsonian emerald. Ryan Park project does not overlap with any habitat and the Fox Creek project might overlap with less than 200 acres of emerald habitat. These 200 acres of possible treatments could reduce emerald habitat if they occur in stands with low or moderate tree mortality.

The analysis for the North Savery project is at completion. This project includes 5816 acres of beetle-killed salvage harvest, 1018 acres of precommercial thinning, and 358 acres of tree clearing around Forest infrastructure.

Vegetation management activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but vegetation management on non-NFS lands in and around the LAVA project area is <20% of vegetation management on the Forest.

Transportation System: Roads can have impacts to wildlife and habitat (Forman et al 1997, Joslin and Youmans 1999). So, it is possible the current road network is reducing a small percentage of suitable habitat across the Forest.

Road construction and reconstruction occur annually in the Forest and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Few weeds occur in Hudsonian emerald habitat. Weed control efforts vary on lands under other ownership.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

Some habitat will remain across the Forest for Hudsonian emerald based on the following:

- Hudsonian emeralds are not known to occur in the Medicine Bow National Forest.
- This project impacts some habitat and reduces some habitat quality.
- Most treatments within habitat will be within the edges of habitat because of design criteria that protect wetlands, moist soils, and water influence zones.
- Stands of designated old growth will be retained across the mountain ranges according to Forest Plan Standards (USDA 2003), maintaining some habitat.
- Some treatment will occur in designated roadless areas, reducing some Hudsonian emerald habitat often unaffected by management actions.
- Snags, recruitment trees, and coarse woody debris may not be retained in WUI treatment areas, reducing Hudsonian emerald habitat.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to White-tailed Prairie Dog – Sensitive Species

Existing Conditions

The white-tailed prairie dog is found from southern Montana, through western and southern Wyoming, western Colorado, and into northeastern Utah. Wyoming makes up approximately 71% of its range. The species naturally does not occupy timbered lands. There is one verified colony in the project area near Sixmile Creek along the Platte River. A colony of about 30 animals appeared in 2002 in an area that had recently burned in the Pelton Platte accounting unit (USDA 2003, Biological Evaluation section). The prairie dogs are present in this location every year except in uncommon years when heavy snow causes the town to contract (Haas, 2018, personal communication). The Forest Service's wildlife observation database shows several other historical observations on private lands adjacent to the Owen Sheep Accounting Unit and Rock Morgan Accounting Unit. These additional observations were recorded as

"not verified", and are documented as uncertain reliability. Where the species could occur, it would be limited to lower elevations at the edge of the Forest. There is minimal potential for expansion onto Forest Service lands because of increasing elevation and forested habitat, and because potential suitable habitat is minimal in size and isolated by topography from existing colonies. White-tailed prairie dog habitat is naturally associated with non-forested intermountain valleys, benches, and plateaus, as well as prairie grasslands. Colonies tend to be on dry sites, with a mostly grass component that is tall and more dense than found in black-tailed prairie dog colonies. It is suspected that the distribution throughout Wyoming is about the same as was historical, based on early records. Threats to this species have been identified as poisoning, shooting, agricultural development, urbanization, and sylvatic plague. White-tailed prairie dogs are not perceived as threatening grazing lands nearly as much as the black-tailed prairie dog because they do not normally remove tall vegetation from around their burrows and within their colony.

No Action Alternative

As discussed above, White-tailed prairie dog colonies do not reside for the long-term on forested portions of the landscape, and in only one known circumstances, will continue to reside annually on the periphery of the Pelton Platte accounting unit. Colonies near the Owen/Sheep accounting unit, Rock/Morgan accounting unit, and Sandy/Battle accounting unit are expected to continue on adjacent private lands, but Habitat on NFS lands is outside the center of existing colonies and is only expected to be occupied, if at all, for short periods when colonies on adjacent lands temporarily expand based on recent wildfire, or successive wet years that create ideal forage conditions. This expansion would be minimal and temporary considering that available habitat on NFS lands is only on the periphery of the colonies. Colonies are expected to return to their original size and location as forage conditions normalize. Under the No Action Alternative White-tailed prairie dog habitat and occupancy is expected to remain at it's current levels which is uncommon, along the periphery of NFS lands, except for the one area near Sixmile Creek.

Modified Proposed Action

Direct and Indirect Effects to White-tailed Prairie Dogs

There will be mixed effects of LAVA project implementation to White-tailed prairie dog, however the overall effects are likely to be negligible to both habitat and individuals.

Timbered stands do not provide prairie dog habitat. Vegetation management and associated temporary roads in these stands will not affect White-tailed prairie dogs.

Where prescribed fire is the management tool, a mix of very small positive and negative impacts could occur to White-tailed prairie dogs and their habitat, where present. During prescribed fire activities, a temporary loss of shrubs and grasses would have a short-term detrimental effect to prairie dogs since they rely on herbaceous material for food. Also, direct effects of fire could harm individual animals. However, in both cases, these short-term negative effects are likely to be negligible because actual occupancy of the species on NFS lands is unlikely to occur. Known habitat and existing colonies occurs several miles off of NFS lands. Furthermore, individual prairie dogs, if they occur, are able to avoid heat and flames by staying in their burrows. The mosaic of vegetation that remains after a fire will continue

to provide temporary forage for prairie dogs. Longer term, succulent grasses and forbs that re-grow after prescribed fire are likely to result in improved habitat conditions for a period of up to 10 years.

Impacts of the proposed actions are summarized below based on the proposed activity (first table) as well as the habitat affected within each accounting unit (second table). For example, since the percentage of available habitat in an AU is low, and the likelihood of the species occupying an AU is low, then the expected impacts to the species and habitat are low, negligible, or none. Impacts of proposed actions are summarized in the table below.

Table 42. Expected impact of each of the different proposed activities to White-tailed prairie dogs.

Activity	Expected Impact to Habitat	Expected Impact to Individuals	Total Impact
Even-aged Timber Stand Treatment	0	0	No Impact
Intermediate Timber Stand Treatment	0	0	No Impact
Other Treatments (prescribed fire, mastication, hand thinning)	Negligible positive habitat trend	Negligible	Negligible
Temporary Roads	0	0	No Impact
Design Features	Negligible Benefits	Negligible Benefits	Negligible
Compliance and Survey Tracking Sheet	Not Necessary	Not Necessary	Negligible

Table 43. Expected impact of the proposed action to White-tailed prairie dogs by accounting unit.

Accounting Unit	% Habitat in AU	Liklihood of changes to occupied habitat	Resulting Change in Habitat Quality/Quantity
BattlePass	Minimal	Low	Negligible
Big Blackhall	0	0	None
BowKettle	0	0	None
CedarBrush	0	0	None
FoxWood	0	0	None
FrenchDouglas	0	0	None
GreenHog	0	0	None
JackSavery	0	0	None
NorthCorner	0	0	None
OwenSheep	Low	Low	Negligible
PeltonPlatte	Low	Low	Negligible
RockMorgan	Low	Low	Negligible
SandyBattle	Low	Low	Negligible
WestFrench	0	0	None

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2,600 acres of timber management in the Ryan park area of the Snowy Range. Similarly, the North Savery project includes additional salvage harvest, precommercial thinning, and tree clearing around infrastructure. These treatments and associated activities will have no cumulative effect to White-tailed prairie dogs.

Transportation System: Road construction and reconstruction occur annually in the Forest and will continue to occur. Routine Forest Service construction and maintenance projects are needed to manage

the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattle guards, and other structures. These treatments do not venture into undisturbed habitat and thus, will have no cumulative effect to White-tailed prairie dogs.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control is limited to small disturbed areas typically adjacent to roads and occur with direct application to undesired herbaceous species. It is not expected to contribute cumulative effects to White-tailed prairie dogs.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent. However, cumulative impacts to white-tailed prairie dogs are not expected to occur.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. There are no known, major utility proposals affecting the project area. White-tailed prairie dog control/removal does not occur as part of continued allotment management and thus would have no cumulative effect.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

- Timber Management and associated projects will not affect White-tailed prairie dogs or their habitat.

- Habitat for White-tailed prairie dogs in naturally uncommon on NFS lands and is mostly unoccupied since it typically does not connect to existing colonies that reside on lower elevation private lands.

- Prescribed fire and other treatments that occur in shrubland/grassland habitat occur almost entirely outside of occupied habitat.

- In the unlikely event that prescribed fire treatments do occur in occupied habitat, small temporary losses to individuals and/or habitat could occur. However, individuals can escape the direct effects of flame and temperature by retreating to their burrows. Also, forage will remain on site because prescribed fire is expected to result in a mosaic of burned and unburned habitat.

- After weeks, months, and for several years following prescribed fire, grasses and forbs are expected to return in abundance to the site and thus result in improved habitat for White-tailed prairie dogs.

- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Brewer's Sparrow – Sensitive Species

Existing Conditions

Brewer's sparrows are widespread in the intermountain West and Great Basin. The species population is declining nationwide, possibly related to loss of habitat from agriculture and development. Brewer's sparrow is a common summer resident in the project area that is closely associated with sagebrush (USDA 2003). They are abundant in sagebrush that is tall and vigorous, but no quantitative surveys have been conducted in the project area.

Brewer's sparrows inhabit open shrublands, primarily sagebrush. Nests are located in the lower portions of shrubs including sagebrush and mountain mahogany. Territories may be found far from open water because the birds obtain necessary water from food (insects in the summer).

Dense stands of sagebrush provide habitat for Brewer's sparrow. Maturing sagebrush stands will continue to provide most habitat features while grass cover inclusions and some bare ground will provide seed and insect food sources (Nicholoff 2003).

Forest-wide surveys have been completed for songbirds across the Forest with standardized sampling since 2008. Table 44 displays results since 2008. Population monitoring results are also available on the RMBO website:
http://rmbo.org/v3/avian/ExploretheData.aspx

Table 44. Brewer's sparrow observations across the Forest.

YEAR	# Observed	Total Survey Points
2008	13	377
2009	3	253
2010	13	329
2011	5	343
2012	13	390
2013	20	405
2014	32	383
2012	17	346
2013	20	405
2014	32	383
2015	17	346
2016	9	234

Brewer's sparrow population changes are linked to alteration of sagebrush shrub steppe habitat (Holmes and Johnson 2005). On the MBNF, primary influences that could potentially have a transformative effect on sagebrush habitat include alteration of natural fire regimes, invasion by exotic plants, and improper livestock grazing (Holmes and Johnson 2005). Improper livestock grazing is not known or expected to

occur in this area based on grazing practices remaining with Forest Plan Standards and guidelines. Conservation and management of Brewer's sparrows should focus on creating and maintaining a sagebrush landscape that replicates conditions historically created by natural processes, including fire frequencies. On the MBNF, there is no information on the historic variety of structural types in grass/shrub/sagebrush habitat. Spring prescribed burns may destroy nests if sagebrush habitat is substantially reduced and adversely alter habitat at the site for several decades. On the other hand, lack of fire and/or lack of grazing can result in stands with too dense shrub cover or forest encroachment to be optimal for the Brewer's Sparrow.

The following Table shows an estimate of available habitat using Grass/Shrub data derived from remote sensing LandFire Data, 2014, which was also compared to the Greater Sage-grouse designated habitat. These two databases overlap and together they approximate the available Brewer's Sparrow Habitat. Almost all of the proposed habitat is within prescribed fire, mechanical, or hand treatment opportunity areas.

Table 45. Estimate of available habitat using Grass/Shrub data derived from remote sensing LandFire Data, 2014.

Accounting Unit	Estimate of Available Habitat in Acres for Greater Sage-grouse and Brewer's Sparrow	Percent of Accounting Unit	GRSG Designated Habitat	GRSG Percent of Accounting Unit	Accounting Unit Size
BattlePass	478	1.0%	656	1.3%	49,439
Big Blackhall	3031	4.1%	11,793	16.1%	73,222
BowKettle	54	0.1%	141	0.2%	64,653
CedarBrush	374	0.6%	507	0.8%	60,899
FoxWood	268	0.3%	205	0.2%	85,605
FrenchDouglas	0	0.0%	0	0.0%	66,092
GreenHog	0	0.0%	0	0.0%	65,940
JackSavery	973	1.2%	2250	2.8%	79,139
NorthCorner	0	0.0%	0	0.0%	45,105
OwenSheep	0	0.0%	0	0.0%	28,803
PeltonPlatte	1073	2.2%	348	0.7%	49,294
RockMorgan	541	0.9%	1455	2.3%	62,313
SandyBattle (Also includes habitat for Sharptailed Grouse)	1350	1.4%	1850	2.0%	94,484
WestFrench	0	0.0%	0	0.0%	69,681
Total	**8,142**	**0.9%**	**19,205**	**2.1%**	**894,669**

No Action Alternative

Direct and Indirect Effects

Under the No Action Alternative, Brewer's sparrow habitat is expected to remain stable where suitable habitat exists. This habitat correlates roughly to sage-grouse habitat. If a large-scale wildfire were to occur (probability unknown but not unexpected over the long-term), it could remove large portions of available habitat. Considering that the species is mobile, and can occupy mature sage-brush that is unaffected by local wildfire, the impacts of a natural event are not expected to cause a loss of occupancy across the landscape. Also, fire disturbances typically burn in a mosaic that would leave islands of unburned habitat which continue to be suitable for Brewer's sparrow.

Modified Proposed Action

Direct and Indirect Effects

Nearly all of the suitable habitat for Brewer's Sparrow is in Prescribed Fire, Mechanical, or Hand Treatment Opportunity Areas. Therefore, there is a minor potential to lose habitat through our proposed action. Individual birds, nests, and suitable habitat may be lost during active prescribed fire or related activities. On the other hand, numerous measures are in place to reduce the amount of proposed activities occurring in Brewer's Sparrow habitat. Standards and guidelines in the Sage-grouse ROD (2015) require any prescribed fire in designated habitat to consider spring timing restrictions, avoidance of nesting habitat (dense sage-brush), and unit design features to move vegetative conditions towards Desired Conditions stated in the plan which trends toward mid to later seral sage-brush, and thus benefit Brewer's Sparrow. As a result, all proposed projects in Brewer's sparrow habitat will be reviewed for their compliance with the Sage-grouse ROD and thus, will minimize disturbances to Brewer's Sparrow whose habitat typically overlaps. Considering that over 68% of prescribed fire Treatment Opportunities exist outside of Brewer's Sparrow habitat, proposed project areas will mostly avoid impacts to Brewer's Sparrow habitat by locating them outside of sage-grouse habitat. When in or near habitat, implementing timing restrictions and other required design features would minimize loss. The following Table shows the estimate of Brewer's Sparrow habitat within each accounting units compared to the Fuels Treatment Opportunity Areas related to prescribed fire that are outside of the available habitat.

Table 46. Estimate of Brewer's Sparrow habitat within each accounting unit compared to the Fuels Treatment Opportunity Areas.

Accounting Unit	Percent of Accounting Unit in Brewer's Sparrow Habitat	Prescribed Fire, and other Fuels Treatment Opportunities outside of Brewer's Sparrow Habitat	Accounting Unit Size in Acres
BattlePass	1.0%	55.0%	49,439
Big Blackhall	4.1%	66.0%	73,222
BowKettle	0.1%	65.0%	64,653
CedarBrush	0.6%	72.8%	60,899
FoxWood	0.3%	89.9%	85,605
FrenchDouglas	0.0%	61.7%	66,092
GreenHog	0.0%	52.2%	65,940
JackSavery	1.2%	88.2%	79,139
NorthCorner	0.0%	66.1%	45,105
OwenSheep	0.0%	78.4%	28,803
PeltonPlatte	2.2%	39.7%	49,294
RockMorgan	0.9%	57.6%	62,313
SandyBattle (Also includes habitat for Sharptailed Grouse)	1.4%	76.4%	94,484
WestFrench	0.0%	74.2%	69,681
Total	**0.9%**	**68.8%**	**894,669**

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. Similarly, the North Savery project includes additional salvage harvest, precommercial thinning, and tree clearing around infrastructure. These treatments and associated activities will have no cumulative effect to Brewer's Sparrow.

Transportation System: Road construction and reconstruction occur annually in the Forest and will continue to occur. Routine Forest Service construction and maintenance projects are needed to manage

the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattle guards, and other structures. These treatments do not remove habitat and thus, will have no cumulative effect to Brewer's Sparrow.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control is limited to small disturbed areas typically adjacent to roads and occur with direct application to undesired herbaceous species. It is not expected to contribute cumulative effects to Brewer's Sparrow.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent. However, ongoing recreation does not remove Brewer's Sparrow habitat and thus, cumulative impacts are not expected to occur.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. Livestock grazing activities are conducted to Forest Plan Standards and guidelines such that shrublands are not reduced in seral stage or converted to grasslands. Thus, continued allotment management and would have no cumulative effect or loss to Brewer's Sparrow or their habitat.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

- Timber Management and associated activities will not affect Brewer's Sparrow or their habitat.

- Habitat for Brewer's Sparrow occurs in mid seral to mature sage-brush which can be affected prescribed fire activities, mastication/conifer removal, and hand thinning activities. The prescribed fire and mastication activities will result in minor reduction of sage-brush, where treated, which in turn can reduce available suitable habitat and if occurring in the spring, can harm nesting individuals.

- Standards and guidelines from the Sage-grouse ROD and Forest Plan Amendment limit the amount, location, and timing of sagebrush removal to an extent that will provide for retention of mid-seral and mature sagebrush. These protection measures will protect both sage-grouse and Brewer's sparrow nesting and foraging habitat to a degree that fosters continued occupancy and reproduction across treated and untreated portions of the landscape.

- Proposed project areas will mostly avoid impacts to Brewer's Sparrow habitat by being located outside of habitat to in order to comply with the Sage-grouse ROD. Over 68% of the prescribed

fire treatment opportunities exist outside of Brewer's Sparrow habitat, so specific project designs will have the latitude to avoid habitat. In limited circumstances when in or near habitat, implementing timing restrictions and other required design features from the Sage-grouse ROD will have a dual benefit of protecting Brewer's Sparrow.

- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Columbian Sharp-tailed Grouse – Sensitive Species

Existing Conditions

This subspecies of Sharp-tailed Grouse occurs in isolated pockets scattered across the western United States west of the continental divide. The species has previously been petitioned for listing twice under the Endangered Species Act and is thought to occupy less than 10% of their historic range (Hoffman et al. 2015). One accounting unit (Sandy Battle Accounting Unit) includes an isolated pocket of Columbian Sharp-tailed Grouse breeding on NFS lands. This population and others in the vicinity appear to be stable in south-central Wyoming such that the Wyoming Game and Fish Department has informally expressed some interest in initiating a hunting season. The University of Wyoming (researchers Pratt and Beck) initiated a three year study starting in 2017. The study will monitor marked birds in this area (and adjacent areas) to identify priority use locations, quantify preferred habitat characteristics, evaluate anthropogenic disturbances avoided by the bird, and clarify subspecies questions as they relate to the plains sharp-tailed grouse.

The species occurs in mid/tall grassland with shrubs including serviceberry, big sagebrush, and mountain snowberry. Bunchgrass and forbs are essential for nesting and brood rearing. In fall and winter, use is concentrated on ridges of mountain shrub and riparian areas. Columbian Sharp-tailed Grouse habitat overlaps Greater Sage-grouse habitat in the Sandy Battle Accounting Unit.

Table 47. Estimate of available habitat for Columbian Sharp-tailed Grouse within each accounting unit.

Accounting Unit	Estimate of Available Habitat in Acres for Columbian Sharp-tailed Grouse	Percent of Accounting Unit	Accounting Unit Size
BattlePass	0	0.0%	49,439
Big Blackhall	0	0.0%	73,222
BowKettle	0	0.0%	64,653
CedarBrush	0	0.0%	60,899
FoxWood	0	0.0%	85,605
FrenchDouglas	0	0.0%	66,092

GreenHog	0	0.0%	65,940
JackSavery	0	0.0%	79,139
NorthCorner	0	0.0%	45,105
OwenSheep	0	0.0%	28,803
PeltonPlatte	0	0.0%	49,294
RockMorgan	0	0.0%	62,313
SandyBattle	1350	1.4%	94,484
WestFrench	0	0.0%	69,681
Total	**1350**	**0.2%**	**894,669**

Disturbance at the lek during display and breeding, overgrazing, fire suppression, and conversion of habitat can be threats to the subspecies. Evaluation criteria for the subspecies are retention of adequate habitat and seasonal protection from disturbance at leks. Burning can be beneficial to the species where it maintains desired vegetation composition and spatial pattern. The Forest Plan calls for a 1 mile timing restriction on disturbances around sharp-tailed grouse breeding complexes March 1 through June 30.

No Action Alternative

Direct and Indirect Effects

Under the No Action Alternative, Columbian Sharp-tailed Grouse habitat is expected to remain stable where suitable habitat exists. This habitat correlates roughly to shrublands and sage-grouse habitat in the Sandy Battle Accounting Unit. Large-scale wildfire could occur that removes a large portion of available habitat here. However, considering that the species is mobile, and can occupy mature sagebrush that is unaffected by local wildfire, and common on adjacent private lands to East, the impacts of a natural fire event would be temporary as birds move to unburned habitat. They would not be expected to cause a loss of occupancy across the landscape. Also, fire disturbances typically burn in a mosaic that leaves islands of unburned habitat which continues to be suitable for Columbian Sharp-tailed Grouse.

Modified Proposed Action

Direct and Indirect Effects

Nearly all of the suitable habitat for Columbian Sharp-tailed Grouse is in proposed Prescribed Fire, Mechanical, or Hand Treatment Opportunity Areas. Therefore, there is a minor potential to lose habitat given the proposed action. Individual birds, nests, and suitable habitat may be lost during active prescribed fire or related activities. On the other hand, numerous measures are in place to reduce the amount of proposed activities occurring in Columbian Sharp-tailed Grouse habitat. Standards and guidelines in the Sage-grouse ROD (2015) require any prescribed fire in designated habitat to consider spring timing restrictions, avoidance of nesting habitat (dense brush), and unit design features to move

vegetative conditions towards Desired Conditions stated in the plan which trends toward mid to later seral shrublands and grasslands, and thus benefit Columbian Sharp-tailed Grouse. As a result, all proposed projects will be reviewed for their compliance with the Sage-grouse ROD and thus, will minimize disturbances to Columbian Sharp-tailed Grouse whose habitat overlaps in the Sandy Battle Accounting Unit. Considering that over 76% of prescribed fire Treatment Opportunities exist outside of Columbian Sharp-tailed Grouse habitat in the Accounting Unit, proposed project areas will mostly avoid impacts to habitat by locating them outside of Columbian Sharp-tailed Grouse habitat. When in or near habitat, timing restrictions and other required design features that minimize loss would be implemented. The following Table shows the estimate of Columbian Sharp-tailed Grouse habitat within each accounting units compared to the Fuels Treatment Opportunity Areas related to prescribed fire that are outside of the available habitat.

Table 48. Available habitat for Columbian Sharp-tailed compared to non-habitat treatment opportunity areas within each accounting unit.

Accounting Unit	Percent of Accounting Unit in Columbian Sharp-tailed Grouse Habitat	Prescribed Fire, and other Fuels Treatment Opportunities outside of Columbian Sharp-tailed Grouse	Accounting Unit Size in Acres
BattlePass	0.0%	55.0%	49,439
Big Blackhall	0.0%	66.0%	73,222
BowKettle	0.0%	65.0%	64,653
CedarBrush	0.0%	72.8%	60,899
FoxWood	0.0%	89.9%	85,605
FrenchDouglas	0.0%	61.7%	66,092
GreenHog	0.0%	52.2%	65,940
JackSavery	0.0%	88.2%	79,139
NorthCorner	0.0%	66.1%	45,105
OwenSheep	0.0%	78.4%	28,803
PeltonPlatte	0.0%	39.7%	49,294
RockMorgan	0.0%	57.6%	62,313
SandyBattle (Also includes habitat for Sharptailed Grouse)	1.4%	76.4%	94,484
WestFrench	0.0%	74.2%	69,681
Total	**0.9%**	**68.8%**	**894,669**

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. Similarly, the North Savery project includes additional salvage harvest, precommercial thinning, and tree clearing around infrastructure. These treatments and associated activities will have no cumulative effect to Columbian Sharp-tailed Grouse.

Transportation System: Road construction and reconstruction occur annually in the Forest and will continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattle guards, and other structures. These treatments do not remove habitat and thus, will have no cumulative effect to Columbian Sharp-tailed Grouse.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control is limited to small disturbed areas typically adjacent to roads and occur with direct application to undesired herbaceous species. It is not expected to contribute cumulative effects to Columbian Sharp-tailed Grouse.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent. However, ongoing recreation does not remove Columbian Sharp-tailed Grouse habitat and thus, cumulative impacts are not expected to occur.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle but several allotments along the Continental Divide include domestic sheep. Livestock grazing activities are conducted to Forest Plan Standards and guidelines such that shrublands are not reduced in seral stage or converted to grasslands. Thus, continued allotment management and would have no cumulative effect or loss to Columbian Sharp-tailed Grouse or their habitat.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

- Timber Management and associated activities will not affect Columbian Sharp-tailed Grouse or their habitat.

- Habitat for Columbian Sharp-tailed Grouse occurs in mature shrubs in the Sandy Battle Accounting Unit which can be affected by prescribed fire activities, mastication/conifer removal, and hand thinning activities. The prescribed fire and mastication activities could result in small to moderate reduction of sage-brush and other shrubs, where treated, which in turn can reduce available suitable habitat. If treatment occurs in the spring, nesting individuals could be harmed.

- Standards and guidelines from the Sage-grouse ROD and Forest Plan Amendment limit the amount, location, and timing of shrub removal to an extent that will provide for retention of mature shrubs and bunch grasses important to Columbian Sharp-tailed Grouse. These protection measures will protect both sage-grouse and Columbian Sharp-tailed Grouse nesting and foraging habitat to a degree that fosters continued occupancy and reproduction across treated and untreated portions of the landscape.

- Proposed project areas will mostly avoid impacts to Columbian Sharp-tailed Grouse habitat by being located outside of habitat to in order to comply with the Sage-grouse ROD. Over 76% of the prescribed fire treatment opportunities exist outside of Columbian Sharp-tailed Grouse habitat in the Sandy Battle Accounting unit. Therefore, specific project designs will have the latitude to avoid habitat. In limited circumstances when in or near habitat, implementing timing restrictions and other required design features from the Sage-grouse ROD will have a dual benefit of protecting Columbian Sharp-tailed Grouse.

- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Effects to Greater Sage-grouse – Sensitive Species

Existing Conditions

In March 2010, the USFWS concluded that the GRSG was warranted but precluded for listing as a threatened or endangered species. In their decision, the USFWS identified the inadequacy of regulatory mechanisms (i.e., LMP conservation measures) as a significant threat to GRSG. In 2015, Regional Foresters in Region 2 and Region 4 signed the Greater Sage-grouse Record of Decision for Northwest Colorado and Wyoming (2015 ROD, (USDA Forest Service. 2015a)). The decision also included Wyoming Forest Plan Amendments (attachment B of the 2015 ROD) which applies to the Medicine Bow National Forest and Bridger-Teton National Forest and includes over 100 standards and guidelines related to sage-grouse conservation.

Greater sage-grouse are a USFS Region 2 Sensitive Species. Sage-grouse are sagebrush obligates, inhabiting landscapes composed of a mosaic of tall sagebrush, low sagebrush, grass, and forbs. Breeding display grounds ("leks") are open areas surrounded by dense sagebrush with 10% to 25% shrub cover available as nesting habitat. Nests are usually placed on the ground beneath big sagebrush with tall grass cover helping to conceal the nests. After the eggs hatch, the brood leaves the nest area. Preferred habitat for young includes moist areas with forbs and insects. Sage Grouse feed on sagebrush leaves in the

winter. In summer, they also eat forb leaves and flowers, and insects (especially grasshoppers during irruptions).

In Wyoming, sage-grouse habitat is generally managed by its' importance to successful breeding which contributes to sustainable populations. The 2015 ROD designated habitat into two main types.

- PHMA is Priority Habitat, which is further subdivided into core habitat (most important breeding or nesting according to the Wyoming Sage-grouse Executive order), connectivity (known migration corridors that connect sub-populations), or sagebrush focal areas (none are present on the MBRTB).
- GHMA is General Habitat. These are occupied seasonal or year-round habitat outside of PHMA and are less important to breeding and nesting functions.
- The above management designations were intended to align closely to the State of Wyoming Executive Order 2015-4 Core Area Protection Order. That is, the Forest Service designated PHMA in areas that the State of Wyoming designated as "Core Habitat". The Forest Service designated GHMA in areas that the State of Wyoming designated as "Non-core Habitat". After the 2015 Record of Decision was completed, the State of Wyoming updated their Core area maps from Version 3 to Version 4. Those changes resulted in some of the Forest Service designations no longer being in perfect alignment with the State maps.

The project area contains both PHMA (hereafter referred to as Priority Habitat) and GHMA (hereafter referred to as General Habitat). These habitats exist primarily along the Forest Boundaries of both the Snowy Range and the Sierra Madre Range where sagebrush begins to dominate the landscape and dense forest is minimal or in isolated pockets. The table below shows which accounting units have designated sage-grouse habitat and if there are any leks within 2 miles of the accounting unit boundary1.

Table 49. Designated Greater Sage-grouse habitat and known leks, listed by accounting unit.

Accounting Unit	PHMA Acres	GHMA Acres	Total Habitat	Comments
Jack Savery	1,069	1,181	2,250	There is one lek (lek 1585153) within 2 miles of the eastern edge of the accounting unit.
Sandy Battle	100	1,751	1,851	There is one lek (lek –North Sheep Mountain) immediately south of the accounting unit, and an unverified lek in

[1] This figure is displayed because the 2015 ROD calls for seasonal timing restrictions on new surface disturbance and disruptive activities in all priority habitat and within 2 miles of leks in general habitat.

Accounting Unit	PHMA Acres	GHMA Acres	Total Habitat	Comments
				the southeast corner of the accounting unit. There is a substantial amount of sage-grouse habitat in the Battle Mountain and Sheep mountain areas that is not designated by the 2015 ROD, but is occupied according to the Wyoming executive order and observation data.
Battle Pass	0	656	656	There is one lek (lek 1585153) within 2 miles of the northern edge of the accounting unit.
Big Blackhall	125	11,668	11,794	There is one Colorado lek that is approximately 2 miles southeast of the southeast corner of the accounting unit.
Rock Morgan	0	1,455	1,455	
Bow Kettle	0	141	141	
Cedar Brush	284	224	507	There is one lek (lek 1782181) within 2 miles of the north western edge of the accounting unit.
Pelton Platte	348	0	348	There is one Colorado lek within 2 miles of

Accounting Unit	PHMA Acres	GHMA Acres	Total Habitat	Comments
				the southern edge of the accounting unit.
Fox Wood	0	205	205	There is one lek (lek – Jelm Mtn. 21) within 2 miles of the southeastern edge of the accounting unit.
Total for Planning Area	1,927	17,281	19,208	

The following tables summarize standards and guidelines from the 2015 ROD that should be considered when designing activities. Forest Plan Standards and guidelines are not typically repeated in this Biological Evaluation for other wildlife species. However, given that the standards and guidelines for Sage-grouse are relatively new and are written in a way that is somewhat complex in the 2015 ROD, the biologist thought it necessary to share the key information from the Sage-grouse Fire and Fuels Implementation Guide (http://fsweb.mbr.r2.fs.fed.us/quick_picks/sagegrouse/2017-3_30_fire_fuels%20mgmt%20implementation%20guide.pdf) which summarizes the most important standards and guidelines. Please refer directly to the 2015 ROD if more specific language is needed.

Table 50. Sage-grouse protective measures summarized from the 2015 Sage-grouse ROD and Forest Plan Amendments that should be applied to all newly authorized ground disturbing activities.

Protective Measure (summary).	**Priority Habitat**	**General Habitat**	**Reference Number from ROD for the Standard (ST), Guideline (GL) or Desired Condition (DC)**
Timing, Density, Disturbance			
Do not authorize new surface occupancy or surface disturbing activities near perimeter of occupied leks.	0.6 miles	0.25 miles	ST-12 and ST-13
Do not authorize new surface activities near leks that create noise at 10dB above ambient. Noise is measured at the perimeter of an occupied lek during lekking (from March 1 to May 15) from 6 p.m. to 8 a.m. Do not include noise	Applies at perimeter of occupied leks	Applies at perimeter of occupied leks	ST-14,

Protective Measure (summary).	Priority Habitat	General Habitat	Reference Number from ROD for the Standard (ST), Guideline (GL) or Desired Condition (DC)
resulting from human activities that have been authorized and initiated within the past 10 years in the ambient baseline measurement.			
only allow new authorized land uses if after avoiding and minimizing impacts, any remaining residual impacts to the greater sage-grouse or its habitat are fully offset by compensatory mitigation projects that provide a net conservation gain to the species	Applies	Applies	ST-15
Seasonal restrictions on new surface disturbance or disruptive activities. March 15 through June 30.	-Applies in all priority habitat	-In general habitat, applies within 2 miles from lek perimeter.	GL-16, GL-17 and GL-18
Anthropogenic disturbance totals	5% cap	No restriction	GL-22
Roads/Transportation			
On road and trail use authorized under a special-use authorization, minimal disturbance would occur during breeding, nesting, and wintering.	March 15 to June 30 And December 1 to March 15	March 15 to June 30 And December 1 to March 15	DC-68
Restrict construction of new maintenance level 4 and 5 roads within 1.9 miles of the perimeter of occupied greater sage-grouse leks	Applies	Does not apply	ST-69
Do not allow any category of road construction near occupied leks	0.6 miles	0.25 miles	ST-70, see ST-72 for exceptions
do not allow improvements to existing routes that would	Applicable	Does not apply	ST-71, unless the upgrading would

Protective Measure (summary).	Priority Habitat	General Habitat	Reference Number from ROD for the Standard (ST), Guideline (GL) or Desired Condition (DC)
change route category or capacity			have minimal impact on the greater sage-grouse; is necessary for motorist safety; or eliminates the need to construct a new road.
If necessary to construct new roads and trails to access valid existing rights, limit construction to the minimum standard, length, and number and avoid, minimize, and mitigate impacts.	Applicable	Does not apply	ST-72
new roads and road realignments should be designed and administered to reduce collisions with the greater sage-grouse.	Applicable	Applicable	ST-74
road construction within riparian areas and mesic meadows should be restricted.	Applicable	Applicable	ST-75. If not possible, constructed perpendicular to ephemeral drainages and stream crossings, unless topography prevents doing so
when decommissioning roads, restoration activity should be designed to move habitat towards desired conditions in table 1 of the 2015 ROD.	Applies	Applies	GL-76
dust abatement terms and conditions should be included in road-use authorizations when dust has the potential to affect the greater sage-grouse.	Applies	Applies	GL-77

Protective Measure (summary).	Priority Habitat	General Habitat	Reference Number from ROD for the Standard (ST), Guideline (GL) or Desired Condition (DC)
road and road-way maintenance activities should be designed and implemented to reduce the risk of vehicle- or human-caused wildfires and the spread of invasive plants.	Applies	Applies	GL-78

The following table summarizes standards and guidelines from the 2015 ROD that should be considered when designing fuels treatment activities. Please refer directly to the 2015 ROD for more specific language.

Table 51. Sage-grouse protective measures that pertain to Fire and Fuels management, summarized from the 2015 Sage-grouse ROD and Forest Plan Amendments.

1. GRSG Standards and Guidelines that Apply to Fuels Treatments in Northwest Colorado and Wyoming, Region 2			
Standard and Guidelines	**Type of GRSG habitat it applies in**	**ROD Reference Number for the Standard or Guideline (abbreviated)**	**Comments**
1. When using prescribed fire for restoration of GRSG habitat, demonstrate in NEPA analysis • how the project would move toward GRSG desired conditions stated in ROD Table 1, • why alternative techniques were not selected, and • how potential threats to GRSG habitat would be minimized.	In priority and general habitat management areas	Standard WY-047, p. 105	Seasonal Habitat Desired Conditions are stated in the ROD, Table 1, page 96
2. Sagebrush removal or manipulation, including prescribed fire, should be restricted unless the removal strategically reduces the potential impacts from wildfire or supports the attainment of desired conditions.	In wintering or breeding and nesting habitat	Guideline WY-063, p. 107	
3. In planned fuels management activities or to mitigate the impacts of wildfire, fire resistant native plant species should be used if available, or consider using fire resistant non-native	In priority and general habitat management areas	Guideline WY-049, p. 105	

1. GRSG Standards and Guidelines that Apply to Fuels Treatments in Northwest Colorado and Wyoming, Region 2			
Standard and Guidelines	**Type of GRSG habitat it applies in**	**ROD Reference Number for the Standard or Guideline (abbreviated)**	**Comments**
species if analysis indicates they will not degrade GRSG habitat in the long term.			
4. Prescribed fire prescriptions should minimize undesirable effects on vegetation and/or soils (e.g., minimize mortality of desirable perennial plant species and reduce risk of hydrophobicity).	In priority and general habitat management areas	Guideline WY-053, p. 106	
5. Sagebrush removal or manipulation, including prescribed fire, should be restricted unless the removal strategically reduces the potential impacts from wildfire or supports the attainment of desired conditions.	In wintering or breeding and nesting habitat	Guideline WY-063, p. 107	
6. Restrict prescribed fire in areas of Wyoming big sagebrush or other xeric sagebrush species, where cheatgrass or other fire-invasives occur, and/or within areas of less than 12 inch precipitation zones, unless necessary for restoration of GRSG habitat consistent with desired conditions.	In priority and general habitat management areas	Standard WY-046, p. 105	
7. Do not authorize new surface disturbing activities on or within a 0.25 mile radius of the perimeter of occupied leks.	General habitat management areas	Standard WY-013, p.99	

Map of Greater Sage-grouse Habitat.

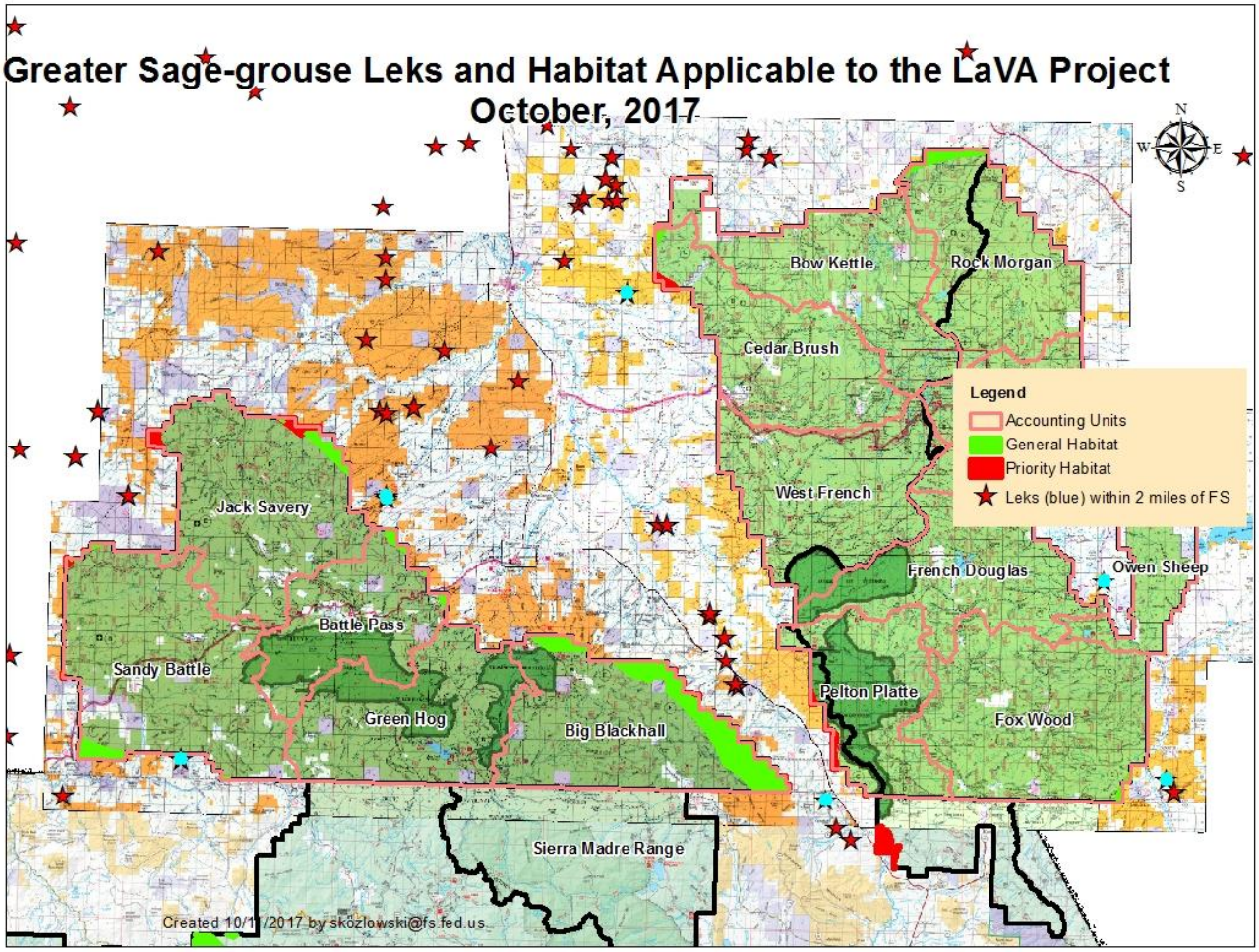

Figure 1 - Map of Greater Sage-grouse Habitat including Sage-grouse leks.

No Action Alternative

Direct and Indirect Effects

Under the No Action Alternative, Greater Sage-grouse habitat is expected to remain stable where suitable habitat exists. This habitat correlates roughly to mature sage-brush and designated sage-grouse habitat which exists in the lower elevations of many of the accounting units. Large-scale wildfire could occur that removes a large portion of available habitat in any given accounting unit. However, considering that sage-grouse are mobile, and the birds can move to occupy sage-brush areas that are unaffected by local wildfire, the impacts of a natural fire event would be temporary as birds move to unburned habitat. Such impacts, should they occur, would not be likely to cause a loss of occupancy across the landscape. Fire disturbances typically burn in a mosaic that leaves islands of unburned habitat which continues to be suitable Greater Sage-grouse.

Modified Proposed Action

Direct and Indirect Effects

Nearly all of the suitable habitat for Greater Sage-grouse is in proposed Prescribed Fire, Mechanical, or Hand Treatment Opportunity Areas. Therefore, there is a small potential to lose habitat given the proposed action. Individual birds, nests, and suitable habitat may be lost during active prescribed fire or related activities. On the other hand, numerous measures are in place to reduce the amount of proposed activities occurring in Greater Sage-grouse habitat. Standards and guidelines in the Sage-grouse ROD (2015) require any prescribed fire in designated habitat to consider spring timing restrictions, avoidance of nesting habitat (dense sage-brush), and unit design features to move vegetative conditions towards Desired Conditions stated in the plan which trends toward mid to later seral shrublands and grasslands, that benefit Greater Sage-grouse. As a result, all proposed activities that occur in or near sage-grouse habitat will be reviewed for their compliance with the Sage-grouse ROD and thus, will minimize disturbances. For the most part, projects will be designed to completely avoid sage-grouse habitat. Considering that over 67% of prescribed fire Treatment Opportunities exist outside of Greater Sage-grouse habitat (see individual accounting units below), specific proposed treatment areas, as they are identified, will mostly avoid impacts to habitat by locating them outside of Greater Sage-grouse habitat. In the less common circumstance when they are located in or near habitat, timing restrictions, adhering to vegetative desired future condition tables, and other required design features will minimize loss and would be designed towards long term improvement of sage-grouse habitat. The following table shows the estimate of Greater Sage-grouse habitat within each accounting unit compared to the Fuels Treatment Opportunity Areas related to prescribed fire that are outside of the available habitat. In most circumstances, fuels treatments activities would be located in those areas outside of Greater Sage-grouse habitat.

Table 52. Greater Sage-grouse habitat within each accounting unit compared to the Fuels Treatment Opportunity Areas that are outside of the available habitat.

Accounting Unit	Greater Sage-grouse Habitat Acres in Accounting Unit	Greater Sage-grouse Habitat Percent of Accounting Unit	% of Accounting Unit that are Prescribed Fire, and other Fuels Treatment Opportunities outside of Greater Sage-grouse Habitat	Accounting Unit Size in Acres
Battle Pass	656	1.3%	53.7%	49,439
Big Blackhall	11,793	16.1%	49.8%	73,222
Bow Kettle	141	0.2%	64.8%	64,653
Cedar Brush	507	0.8%	72.0%	60,899

Accounting Unit	Greater Sage-grouse Habitat Acres in Accounting Unit	Greater Sage-grouse Habitat Percent of Accounting Unit	% of Accounting Unit that are Prescribed Fire, and other Fuels Treatment Opportunities outside of Greater Sage-grouse Habitat	Accounting Unit Size in Acres
Fox Wood	205	0.2%	89.6%	85,605
French Douglas	0	0.0%	61.7%	66,092
Green Hog	0	0.0%	52.2%	65,940
Jack Savery	2250	2.8%	85.3%	79,139
North Corner	0	0.0%	66.1%	45,105
Owen Sheep	0	0.0%	78.4%	28,803
Pelton Platte	348	0.7%	39.0%	49,294
Rock Morgan	1455	2.3%	55.3%	62,313
Sandy Battle	1850	2.0%	74.4%	94,484
West French	0	0.0%	74.2%	69,681
Total	**19,205**	**2.1%**	**66.6%**	**894,669**

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. Similarly, the North Savery project includes additional salvage harvest, precommercial thinning, and tree clearing around infrastructure. These treatments and associated activities will have no cumulative effect to Greater Sage-grouse.

Transportation System: Road construction and reconstruction occur annually in the Forest and will continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattle guards, and other structures. These treatments typically do not remove habitat.

Although these activities can disturb active sage-grouse leks, no leks are located on the Forest and thus, management of the existing transportation system will have no cumulative effect to Greater Sage-grouse.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to decreasing levels. Weed control is typically to small disturbed areas adjacent to roads and occurs with direct application to undesired herbaceous species. It is not expected to contribute cumulative effects to Greater Sage-grouse.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent. However, ongoing recreation does not remove Greater Sage-grouse Grouse habitat and there are not leks on NFS lands. Thus, cumulative impacts from recreation are not expected to be of concern.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle grazing but several allotments along the Continental Divide include domestic sheep. Livestock grazing activities are conducted to Forest Plan Standards and guidelines such that shrublands are not reduced in seral stage or converted to grasslands. Recent analysis of allotment conditions in the project area compared to sage-grouse habitat (located in district files) indicates that except for occasional small/localized disturbances, grazing activities are maintaining suitable habitat conditions where the landscape is capable of producing such conditions. Thus, continued allotment management is not causing cumulative effects concerns to Greater Sage-grouse or their habitat.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

- Timber Management and associated activities will not affect Greater Sage-grouse or their habitat.

- Habitat for Greater Sage-grouse occurs in sagebrush shrublands in most of the accounting units and can be affected by prescribed fire activities, mastication/conifer removal, and hand thinning activities. The prescribed fire and mastication activities could result in small to moderate reduction of sage-brush and other shrubs, where treated, which in turn can reduce available suitable habitat. If treatment occurs in the spring or early summer, young individual sage-grouse could be harmed if they cannot adequately escape fire.

- Standards and guidelines from the Sage-grouse ROD and Forest Plan Amendment limit the amount, location, and timing of shrub removal to an extent that will provide for retention of a mosaic of mature shrubs, dense grasses, and preferred forbs important to Greater Sage-grouse. These protection measures will protect sage-grouse brood rearing habitat and potential nesting habitat to a degree that fosters continued occupancy and reproduction across treated and untreated portions of the landscape.

- Proposed project areas will mostly avoid impacts to Greater Sage-grouse habitat by being located outside of habitat to in order to comply with the Sage-grouse ROD. Over 66% of the prescribed fire treatment opportunities exist outside of Greater Sage-grouse habitat. Therefore, specific project designs, when they occur, will have the latitude to avoid habitat in most situations. In limited circumstances when in or near habitat, implementing timing restrictions and other required design features from the Sage-grouse ROD will minimize impacts.

- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003) and the 2015 Sage-grouse ROD and Forest Plan Amendment.

Effects to Western Bumble Bee – Sensitive Species

Existing Conditions

Western bumble bee (*Bombus occidentalis*) exists in the United States including northern California, Oregon, Washington, Alaska, Idaho, Montana, western Nebraska, western North Dakota, western South Dakota, Wyoming, Utah, Colorado, northern Arizona, and New Mexico. Although bumble bees have been observed in the project area by biological technicians, attempts to photograph and identify the species as Western bumble bee have not yet resulted in positive identification. It is assumed that Western bumble bees commonly occur on the MBNF and the project area, although their abundance and habitat use has not been quantified. Bumble bees are generalist foragers, gathering pollen and nectar from a wide variety of flowering plants. Western bumble bees are known to feed from more than 50 genus of wildflowers (Evans et al. 2008). Since bumble bee colonies obtain all their nutrition from pollen and nectar, they need a constant supply of flowers in bloom. Western bumble bee populations have declined 72%-96% across their native distribution. In 2007, western bumble bees were found at one quarter of the survey sites they had been collected historically.

On March 16, 2016, the USFWS published a notice of petition findings regarding Western bumble bee USDI Fish and Wildlife Service, 2016). They found that the petition presented substantial scientific or commercial information indicating that the petitioned actions may be warranted. They announced their plan to initiate a 12 month review of the status of these species to determine if the petitioned actions (list as threatened or endangered) is warranted. In a review of the petition, the USFWS documented the following information regarding claims of the petitioner:

- Regarding urban development, livestock grazing, and fire suppression, the petitioner did not present substantial evidence of those activities as a threat to the species.
- Regarding concerns whether the existing regulatory mechanisms are adequate to address the current threats, the USFWS concluded that the regulations regarding the use of neonicotinoid pesticides may be inadequate to protect the species and thus, will be further evaluated during the 12-month status review process.
- The USFWS agrees with the petitioner's assertion that agricultural intensification is frequently correlated with heavy pesticide use, which may be a concern for the species.
- The petitioners did provide substantial evidence that the Nosema bombi pathogen is a likely contributor to the western bumble bee decline and that disease may present a threat such that the petitioned action may be warranted.

- Regarding climate change, the USFWS concluded that potential threats associated with pesticides, small population size, climate change, or some other presently unknown natural or manmade factor may be contributing to this decline and may be affecting the continued existence of the western bumble bee, and thus, will be further evaluated during the 12-month status review process.

No Action Alternative

The beetle kill epidemic during the previous 10 years across the forested landscape has caused widespread mortality to forested stands, and will result in a greater abundance and variety of flowering plants compared to what existed prior to the epidemic. As has been found elsewhere, this greater abundance and diversity in floral resources would benefit this species as well as other pollinator species. The No Action does not have any reforestation or site preparation activities therefore the understory that develops naturally would persist within all areas for a greater duration than compared to the Proposed Action.

Modified Proposed Action

Direct and Indirect Effects

All or most of the different types of proposed treatments are expected to have mixed positive and negative effects to Western bumble bees. Ground disturbance associated with timber activities such as stand regeneration, intermediate harvest treatments, pre-commercial thinning, and temporary road construction would initially cause a loss in habitat during the season of treatment and mortality to some individual Western bumble bees if present. During the first spring and early summer after treatment, relatively little flowering plant life is expected to re-grow prior, so the presence of western bumble bees across the landscape will be fewer as compared to subsequent years. There may be direct disturbances to foraging individuals and occasional mortality from mechanized equipment. Due to the mobile nature of this species and its ability to fly away from mechanical disturbances; direct mortality is expected to be minimal. Approximately one year after treatment and for a moderate number of years following the disturbance, the ground is expected to experience an increase in wildflower production since tree overstory competition for light and moisture has been removed or reduced. Similarly, with prescribed fire activities, there may be a short term-loss of vegetation that negatively affects Western bumble bees, however the regrowth of flowering plants is expected to begin during the same season with improved habitat conditions continuing for several years. Regarding both the timber and fires disturbances discussed above, the temporary losses are not of concern because only a comparatively small amount of habitat (several thousand acres) would be treated in any given year compared to hundreds of thousands of acres of available habitat. Thus, negative impacts are short term, estimated to occur on only a small percentage of available habitat in any given season, while adjacent and undisturbed habitat continues to support the Western bumble bee population where it exists. One year after the disturbance and for a moderate number of years following, floral resources available to the Western bumble bee would be improved.

Cumulative Effects

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

Vegetation Management: The Forest is currently preparing 2 Farm Bill CEs in the LAVA project area to address insects and disease. These include up to 3,000 acres of timber management in the Fox Creek area and 2600 acres of timber management in the Ryan park area of the Snowy Range. Similarly, the North Savery project includes additional salvage harvest, precommercial thinning, and tree clearing around infrastructure. These treatments add to the cumulative effects across the landscape to Western bumble bees by adding mechanical disturbances to the ground cover which may temporarily destroy flowering plants used by Western Bumble Bees. However, that disturbance is short-lived and flowering plants are expected to return to treated areas within one or two years. Many flowing plants will return at increased densities because of removal of the overstory and added sunlight and soil moisture, thus benefitting the bee. Overall, the cumulative effects are minimal because they result in off-setting effects that include a temporary loss to flowering plants, followed by a temporary increase in flowering plants, and the disturbances occur at a relatively small scale compared to a larger landscape.

Transportation System: Road construction and reconstruction occur annually in the Forest and will continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures. These treatments typically do not remove habitat except at very small scales such as when clearing brush alongside a road. Although these activities can disturb Western bumble bees and their habitat, they occur at such a small scale that management of the existing transportation system is not expected to be of any concern regarding cumulative effects to Western bumble bee.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to decreasing levels. Weed control is typically to small disturbed areas adjacent to roads and occurs with direct application to undesired herbaceous species. The activity does contribute to cumulative loss of a small amount of flowering habitat. However, treatments are very small in size, often measured in square feet, and add up only to a small amount of habitat (tens to hundreds of acres) across hundreds of thousands of acres of total available habitat. Therefore, cumulative effects from noxious weed treatments are not of concern.

Recreation: The Forest provides an abundance of motorized and non-motorized recreation opportunities. These activities range from no impact to wildlife where encounters are brief and infrequent to moderate impacts to wildlife where encounters are more continuous and consistent. Ongoing recreation does not remove Western bumble bee habitat and thus, cumulative impacts from recreation are not expected to be of concern.

Other: Livestock grazing occurs across the LAVA project area and is expected to continue. Most allotments include cattle grazing but several allotments along the Continental Divide include domestic sheep. Livestock grazing activities are conducted to Forest Plan Standards and guidelines such that shrublands and grasslands are not reduced in seral stage or converted to bare ground. Range allotment analysis of the vegetative conditions in the project area indicates that grazing activities are maintaining productive forage conditions with adequate and diverse ground cover. Such conditions maintain habitat for Western bumble bees. Thus, continued allotment management is not causing cumulative effects concerns to Western bumble bees or their habitat.

Determination of Effects

May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.

- The primary known threats to western bumble bees is agricultural development associated with heavy pesticide use as well as the spread of a pathogen (Mosema bombi). The proposed activities do not involve heavy pesticide use nor are they known to affect the spread of the pathogen.
- Proposed treatment opportunities include timber harvest activities, prescribed fire activities, temporary road construction, and other activities all of which have moderate potential for ground disturbance and a loss of flowering plants that make up western bumble bee habitat. Similarly, mortality may result to individual western bumble bees if they come into contact with operating mechanized equipment, or flame.
- Loss of individual bees is expected to be minimal because the species is mobile and can fly away from disturbances.
- Loss of habitat from disturbances is not expected to have large-scale deleterious effects because only a relatively small amount of habitat is affected in any given season (several thousand acres), while the amount of available habitat that remains undisturbed is several magnitudes larger (several hundred thousand acres).
- Loss of flower habitat during disturbances is short-term, lasting only for about one year, then the disturbed ground is expected to re-vegetate, including suitable wild-flowers, to a condition that is equal to or better for western bumble bees than the habitat that existed prior to the disturbance. This improvement is associated with the increased sunlight, soil moisture, and reduced competing vegetation associated with the treatments.
- The proposed activities are consistent with the revised Forest Plan Standards (USDA 2003).

Landbirds

Under the National Forest Management Act (NFMA), the Forest Service is directed to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives." (P.L. 94-588, Sec 6 (g) (3) (B)). The USDA Forest Service Landbird Conservation Strategic Plan (USDA 2000), Executive Order 13186 (2001), Partners in Flight (PIF) conservation plan for Wyoming (Nicholoff 2003), PIF North American Landbird Conservation Plan (Rosenberg et al. 2016) all reference goals and objectives for integrating bird conservation into forest management and planning. For example, Wyoming Partners in Flight (Nicholoff 2003) in their Best Management practices recommends for conifer forest: "*Provide a variety of forest habitat conditions and structural characteristics across the landscape to meet the habitat needs of most bird species. Design timber programs to provide the widest diversity of vegetation, allowing some forest plots to grow beyond their maximum productive age while cutting others to provide various stages of regenerating vegetation*" (p. 32).

The LAVA project is consistent with the Medicine Bow Forest Plan (USDA 2003) and implements direction identified in the revised Forest Plan. Opportunities to promote conservation of migratory birds and their habitats in the project area were considered during development of the project as guided by the revised Forest Plan. All applicable standards and guidelines from the Forest Plan are incorporated into the analysis by reference. The Medicine Bow National Forest (USFS) coordinated and consulted (USDI 2003) with the U. S. Fish and Wildlife Service (FWS) to develop the revised Forest Plan. The coordination and consultation included review of effects of fuels management activities and silviculture management. The FWS "acknowledged that the USFS attempted to minimize some impacts to wildlife and other natural resources by including conservation measures" (Standards and Guidelines) (USDI 2003, p. 7).

The project applies the Forest Plan Standards and Guidelines in part to help conserve landbirds and their habitat. For example, raptor nests have been and will continue to be surveyed for and proposed harvest units will be designed to retain 90 acres of nesting habitat around nests in occupied goshawk territories. Secondly, no harvest activities will occur within 0.25 miles of active goshawk nests from April 1 through August 30. State and regional Partners in Flight conservation plans were reviewed during project design to ensure that protection measures are in alignment with partner agency goals for landbird management. Additional Best Management Practices and activities from the Watershed Conservation Practices Handbook would be incorporated during implementation to protect wetlands, riparian areas, and soils which would also conserve habitat important to some bird species.

Executive Order 13186 (EO) (2001) directs federal agencies to conserve migratory bird populations, minimize impacts of agency actions on migratory bird resources as practicable, and restore and enhance migratory bird habitat as practicable. The environmental analysis evaluated impacts to migratory birds that might be affected by the proposed action, with emphasis on species of concern and ensured projects would not have a measureable negative effect on migratory bird populations (EO p. 3855). The environment analysis concluded that lodgepole pine stands with high amounts of pine beetle mortality provided greatly reduced habitat quality or created unsuitable habitat for many species. The terrestrial

wildlife Biological Evaluation for Sensitive Species (BE) concluded that some habitat proposed for silviculture or fuels treatment was already in a degraded condition and treatment actions would have small impacts to several migratory birds and their habitat.

These reports acknowledge some disturbance during activities and small amounts of temporary, sometimes longer term, habitat loss in some cases. Treatment of dead and dying lodgepole pine will regenerate these forest stands, creating early forest habitat for some migratory birds. This management is consistent with Wyoming Partners in Flight (Nicholoff 2003) recommendations to "*Provide a variety of forest habitat conditions and structural characteristics across the landscape to meet the habitat needs of most bird species"*. This management is also consistent with Forest Plan direction to "Provide ecological conditions to sustain viable populations of native and desired non-native species" by "Implement management practices such as prescribed burning, timber harvest, thinning, and livestock grazing that mimic natural disturbances to move landscapes toward desired vegetation composition and structure." The view of lodgepole pine stands with high tree mortality not providing quality habitat is similar to results from annual monitoring of birds on the Medicine Bow National Forest. The Forest is a partner in Integrated Monitoring in Bird Conservation Regions (IMBCR) conducted by the Bird Conservancy of the Rockies. The most recent summary of results (2009-2016) for the Medicine Bow National Forest generally suggest brown creepers and three-toed woodpeckers have declined while olive-sided flycatchers are relatively stable at low density (White et al. 2017). Brown creepers and three-toed woodpeckers, in particular, would be expected to decline in the face of dying lodgepole stands and a parallel reduction in insect prey.

The project is also consistent with the recent amendment to the Forest Plan for Greater sage-grouse (USDA 2015). The amendment provides Standards and Guidelines to conserve Greater sage-grouse populations and habitat. As a consequence, the amendment conserves habitat for other sagebrush obligates such as the Brewer's sparrow, a migratory bird species addressed in the terrestrial wildlife BE.

HABITAT IMPROVEMENT OPPORTUNITIES

There are several habitat improvement opportunities for terrestrial wildlife with the LAVA project. All opportunities would be evaluated with field surveys but existing information suggests several options. Rocky mountain juniper has increased in density beyond the density that is naturally expected in several upland shrub areas. The understory immediately surrounding these trees is limited in production. The higher density of junipers takes up space that could be occupied by sagebrush or mountain shrubs, which are more palatable to big game animals. These tall features also reduce the quality of the habitat for sage-grouse and bighorn sheep. There are several hundred acres to a few thousand acres of treatment opportunity for removing dense Rocky Mountain juniper.

Most mountain shrublands, including Gambel oak, consist of older aged plants. The individual plants are less productive than younger plants. The lack of younger mountain shrubland stands is limiting the recruitment of stands to a mature stage, where they will be available to wildlife above the snow and still

be productive. There will be terrestrial wildlife benefits to creating a mosaic of age classes of mountain shrub stands. There are several thousand acres of treatment opportunity in these stands.

There are also some sagebrush shrublands that are in a decadent shrub condition that would benefit terrestrial wildlife with regeneration. For example, there are 35,000 acres of sagebrush shrubland just on the Brush Creek-Hayden District in the project area. Among these, 16,300 acres have been experienced chemical treatment, prescribed fire, or wild fire since 1970. Field evaluation will determine sagebrush shrubland condition and age class distribution to identify treatment areas. All treatments would follow guidance in the recent sage-grouse amendment (USDA 2015).

Many aspen stands in the project area are in an old age class or have a considerable conifer component. There is a lack of younger age classes across the project area. Terrestrial wildlife would benefit from a greater diversity of age clases. Other stands would be more productive and be maintained longer if conifers were removed. There are about 20,000 acres of older aspen that could benefit from regeneration and approximately 18,000 acres that could be promoted with conifer thinning. Only 2800 acres have been treated since the 1970s.

There could be as many as 35,000 acres of lodgepole pine stands that have high tree mortality rates or have experienced at least a 60% reduction in canopy cover. These stands provide low habitat quality to many terrestrial wildlife. These stands are considered “currently unsuitable” habitat for Canada lynx, for example. These stands will be evaluated in the field and stands with high tree mortality and low understory productivity could be regenerated to provide future quality wildlife habitat.

There are small pockets of ponderosa pine and Douglas-fir across the landscape. These are often a small component of lodgepole pine stands. These are unique habitat features across the landscape. Thinning of other tree species around and within these clumps of ponderosa pine and Douglas-fir would promote the longevity of these and slightly expand their distribution.

There are several thousand acres of mature spruce-fir stands that lack some multi-story characteristics within the stands. Removal of individual trees or small group selection in the areas that lack structural diversity can promote future structural diversity within the stands. This structure will benefit several terrestrial wildlife species addressed above that dependent on old forests.

SECURITY AREAS

Security areas (Hillis et al. 1991) are blocks of forested cover $\geq$1/2 mile from an open road and $\geq$250 acres in size. Security areas were originally defined for bull elk survival but these large areas of cover, free of disturbance, are important for many wildlife species (USDA 2003, p. 3-262). The revised Forest Plan has a guideline 1) *to maintain or increase security areas composed of blocks of hiding cover >250 acres over ½ mile from any roads or motorized trails that are open to motorized use* (p. 1-40), 2) *evaluate current and desired open road density at the geographic area scale and design projects, including road*

management to provide adequate security areas for wildlife and limit disturbances during parturition, nesting, and fledging periods (p. 1-41)*,* 3) *cluster disturbance in time and space to maintain security areas* (MA 3.5, p. 2-43)*, Close non-essential roads to enhance or develop large areas for wildlife security and nonmotorized recreation opportunities* (MA 5.15, p. 2-62), and 4) *Identify and manage areas greater than 250 acres in size as needed to provide adequate wildlife security areas.* (MA 5.15, p. 2-64)*.*

LAVA implementation will not be able to meet these guidelines in all cases. Opening of closed roads for vegetation management and construction of temporary roads through security areas will prohibit these areas from functioning as security areas while these roads are open for implementation use. If a temporary road is used for 2 seasons, for example, and obliteration will occur by the end of 3 years after use, then a surrounding security area would not serve its function for 5 years.

If vegetation is removed from the security area with stand initiation treatments, then security areas would not exist at the site again until there is sufficient regeneration to hide 90%t of an adult elk at 200 feet or less (hiding cover) across 250 acres. Hiding cover can be restored within 15 to 25 years. Intermediate treatments might not retain sufficient cover to retain function as security areas.

Additionally, security areas are at least 250 acres in size. LAVA treatments have the potential to remove only a portion of the vegetation in a few security areas but temporarily eliminate the entire polygon as security habitat until cover is restored. There are only 8 locations in the project area where removal of a portion of a security area will reduce the area to less than 250 acres. Most security areas are far too large to be removed by small treatment acreages within their boundaries.

There are 123,000 acres of security areas in the LAVA project area. There are 51,700 acres of security areas in LAVA mechanical or prescribed fire Treatment Opportunity Areas. These security areas could be removed temporarily by vegetation management.

Table 36. Security Areas and potential treatment by Accounting Unit (acres).

Accounting Unit	Security Areas	Potential Vegetation Removal in Security Areas
BattlePass	12,697	2652
Big Blackhall	13,088	4696
BowKettle	5533	2740
CedarBrush	3797	1704
FoxWood[1]	135	135
FrenchDouglas	9837	1475
GreenHog	19,952	7815
JackSavery	9905	7768

NorthCorner	4806	2946
OwenSheep	8705	8681
PeltonPlatte	9359	571
RockMorgan	16,024	5821
SandyBattle	5711	4187
WestFrench	3575	596

1 Security area in Foxwood is a portion of a large security area across several Accounting Units

ROADLESS CHARACTERISTICS

Existing Conditions

There are 25 roadless areas within the LAVA project boundary. These 230,239 acres incorporate every habitat type for every terrestrial wildlife species of concern that occurs in the project area. These roadless areas include every level of habitat change that occurred with the recent insect/disease outbreak. For example, these roadless areas include stands of dry, climax lodgepole with higher tree mortality rates and high elevation spruce-fir stands with much less tree mortality from the insect/disease outbreak.

3) Diversity of Plant and Animal Communities

No Action Alternative

All wildlife present in the 25 roadless areas will persist with no action. Habitat for each species will persist. Habitat for each species also exists outside of these roadless areas; there are no habitats or wildlife species unique to these roadless areas. Forest Plan designated old growth occurs in every one of these roadless areas. Forest Plan defined wildlife security areas occur in 23 of the 25 roadless areas, excluding Battle Creek and Savage Run.

Modified Proposed Action

There could be as many as 124,287 acres of treatment in the roadless areas. Treatment opportunities range from 5% (285 acres) of the French Creek roadless area to 100% of the Bridger Peak, Pennock

Mountain, and Sheep Mountain roadless areas (36,901 acres). However, it is unlikely 100% of any roadless area will be treated.

There could be treatment in all habitat types present in roadless areas with the exception of wetland/riparian habitats since they are protected by the Design Features for wetlands, moist soils and water influence zones described in the DEIS. This habitat is also protected by design features outside of roadless areas.

Theoretically, all designated old growth stands could be removed from the Little Sandstone (570 acres), Bridger (301 acres), Pennock (2685 acres), and Sheep Mountain (2185 acres) roadless areas. Treatment Opportunity Areas overlap all old growth in these 4 roadless areas. Old growth representation on the landscape is tracked by mountain range, so old growth stands can be removed for management needs in one area, a roadless area for example, and replaced in another area in the same mountain range.

4) Habitat for Threatened, Endangered, Proposed, Candidate, and Sensitive (TESP) Species, and Those Species Dependent on Large Undisturbed Areas of Land

No Action Alternative

There is habitat for each species of concern, Region 2 sensitive species, and federally threatened species (Canada lynx) among the roadless areas. Habitat for each species of concern, Region 2 sensitive species, and federally threatened species (Canada lynx) will persist. Habitat for each species also exists outside of these roadless areas. No proposed or candidate species occur in these areas. Forest Plan defined wildlife security areas occur in 23 of the 25 roadless areas, excluding Battle Creek and Savage Run.

LAUs or linkage corridors for Canada lynx occur in almost every roadless area. Big Sandstone, Little Sandstone, Battle Creek, and Sheep Creek roadless areas do not include a LAU or linkage corridor. Illinois Creek and Platte River Additions roadless areas occur only in the Snowy Range linkage corridor. Every LAU and linkage corridor also occurs outside of the roadless areas.

Modified Proposed Action

Security areas (Hillis et al. 1991) are blocks of forested cover $\geq$1/2 mile from an open road and $\geq$250 acres in size. Security areas were originally defined for bull elk survival but these large areas of cover, free of disturbance, are important for many wildlife species (USDA 2003, p. 3-262). In theory, all Forest Plan defined security areas could be removed from the Little Sandstone, Strawberry Creek, Sheep Mountain, and Pennock Mountain roadless areas, 12,019 acres of 135,842 acres present in the LAVA project area. LAVA project includes stand initiation by prescribed fire or by mechanical means. Stand initiation can occur in stands with higher tree mortality, in stands that reach CMAI, or that have

moderate levels of disease such as mistletoe. Stands with higher tree mortality often provide security area cover with coarse woody debris. Stands at CMAI and with mistletoe should have enough cover to provide security cover. Lava project could result in fewer security areas in roadless areas. The amount of security area removal will be dependent on where treatment polygons are later identified and the type of treatment identified for those polygons. For example, intermediate treatments could retain security areas since some horizontal cover will be retained.

Canada lynx and American marten are 2 species often considered to benefit from large undisturbed areas. Effects of proposed actions to Canada lynx are addressed in the Biological Assessment. In summary, LAVA project will utilize approximately 13,000 acres of the exemptions and exceptions that are available when a project does not meet one or all of the 4 vegetation management standards in the Southern Rockies Lynx Amendment. Several LAUs will exceed 30% unsuitable habitat and several LAUs will exceed converting ≥15% of LAU habitat to unsuitable condition in 10 years. These results will occur most often because of the need to complete WUI treatments. These treatments will occur in roadless areas that overlap LAUs and outside roadless areas. In this sense, there could be some reduction in undisturbed areas in roadless if a substantial amount of these exemptions or exceptions are placed in roadless areas.

Some amount of marten habitat in roadless areas will be treated. Some or all of those treatments could result in those areas becoming unsuitable to marten use in the short (some intermediate harvests) to long term (stand initiation). That total will be determined by on site field surveys but the amount could be considerable. For example, there could be as much as 35,000 acres of vegetation management in marten habitat among the 25 roadless areas. The end result is that some marten territories will be affected in areas where management effects do not often occur.

IMPACTS OF ROADS TO WILDLIFE

There will be no new permanent road construction under the LAVA project. There will be 600 miles of temporary road construction and any of these temporary roads could be open for project implementation at any time. Temporary roads will not be open for public use; they will be available only for project implementation. Each temporary road will be obliterated within 3 years after its use. Obliteration methods will prohibit future public use and return the road surface to the surrounding landscape.

An increasing amount of information is available addressing the impacts of roads and motorized travel on wildlife and wildlife habitat. Two useful summaries of this information are Coffin (2007) and Forman et al. (1997). These references are included among the literature reviewed and summarized in Appendix A concerning road impacts to wildlife.

Existing open roads on the Forest will continue to have influences on wildlife and wildlife habitat as described in Appendix A where applicable. LAVA implementation will increase some of those impacts due to the increased vehicle traffic associated with implementation. Use of temporary roads will also increase impacts to wildlife and habitat while those temporary roads are in operation.

Closed roads also have an impact to wildlife and habitat. Closed roads might develop some vegetation over time. Closed roads receive motorized use less frequently than open roads. However, closed roads still receive a variable amount of motorized use that imparts disturbance to wildlife, limits vegetation reestablishment, and maintains a road prism. Closed roads are still available for limited to frequent annual use for permitted activities such as ditches, reservoirs, and private residences. Closed roads are also available for motorized use by local, state, and federal government needs and search and rescue operations, for example. Unfortunately, closed roads are used also for motorized access by some of the public without authorization on a sporadic but regular basis. Therefore, while closed roads will be used for LAVA implementation, the increased impact to wildlife and habitat is not as great as the impact from using a new road.

Most early work and considerable recent work centers on impacts of roads to elk. Application of the knowledge gained from these research efforts has expanded to address other species. Substantial research indicates that habitat quality and quantity for many wildlife are reduced near roads. Effects are commonly identified as direct loss of habitat, reduced habitat quality, expansion of invasive species, changing landscape pattern of habitat, increased territory size, increased predation, increased parasitism, vehicle caused mortality, reduced foraging opportunities, reduced fitness from disturbance, reduced productivity, increased stress, harassment or other disturbance.

RECOMMENDED CONSERVATION MEASURES TO AVOID, MINIMIZE, OR MITIGATE ADVERSE EFFECTS

Design features incorporated into the modified proposed action are identified in the draft and final EIS. Design features important to a particular species analyzed above were discussed for that species in the analysis.

COMPLIANCE WITH REGULATORY DIRECTION

LAVA project is consistent with Forest Plan Standards. Security areas will be decreased. LAVA project is not consistent with Forest Plan guidelines (p. 1-40, 2-43) to maintain or increase security areas.

RESPONSIBILITY FOR REVISED ANALYSES

This analysis was prepared based on presently available information. If the action is modified in a manner that causes effects not considered, or if new information becomes available that reveals that the action may impact terrestrial wildlife species that in a manner or to an extent not previously considered, new or revised analysis will be required.

CONTACTS

Contacts with the US Fish and Wildlife Service are detailed in the Biological Assessment. Coordination of the project with the Wyoming Game and Fish Department (WGFD) is captured in the project file notes detailing WGFD participation in the development of this project.

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APPENDIX A. A REVIEW OF LITERATURE CONCERNING ROAD IMPACTS TO WILDLIFE

Morgantini, L.E. and R.J. Hudson. 1979. Human disturbance and habitat selection in elk. Pages 132-139 *in* M.S. Boyce and L.D. Hayden-Wing, eds. North American Elk: Ecology, Behavior and Management. University of Wyoming, Laramie, Wy. 294pp.

Habitat use in winter strongly related to time of day and distance to roads but not weather conditions. Elk moved from open habitats to tree cover by mid-day and reversed routes toward evening. Amount of time spent in open habitats toward evening was related to traffic activity. Grazing usually occurred within 100-200m of cover until darkness when elk made better use of available range.

In spring elk moved from cover in the afternoon, similar to winter. However, elk bedded at feeding sites near cover until darkness; then moved to grassland areas near roads. At another location away from roads, elk remained in the open throughout the day in spring.

A late elk hunting season (January-February) caused elk to move away from roads (>0.5 mi) and to higher elevations. No elk were found on the grasslands near the roads during this time. Elk returned to lower elevations and grasslands near roads (<0.5 mi.) when hunting and road use ceased.

Results suggest elk moved in response to road use and hunting activity; not in response to weather or habitat preference. Authors suggested this form of harassment could be significant in severe winters when energy budgets are affected by even small changes in quality and amount of nutrition.

Rowland, M.M., M.J. Wisdom, B.K. Johnson, and M.A. Penninger. 2004. Effects of roads on elk: Implications for management in forested ecosystems. Pages 491-508 *in* J. Rahm, editor. Trans. of the 69th North American wildlife and natural resources conference. Wildlife Management Institute. Spokane, WA.

Rowland and others determined that roads have 2 effects on elk: indirect effects on habitat and direct effects to elk and populations. The primary habitat effect is fragmentation to a point that cover eventually is no longer large enough for habitat to be effective. Roads also distribute weeds, leading to loss of habitat quality. Habitat loss for elk from roads is believed to be about 5 acres/mile. Related to direct effects, elk avoid roads and have larger home ranges in areas with more roads, have higher stress and more movement. Elk also have lower survival rates with more roads.

Rowland, M.M., M.J. Wisdom, B.K. Johnson, and J.G. Kie. 2000. Elk distribution and modeling in relation to roads. J. Wildl. Manage. 64(3):672-684.

Authors studied 89 cow elk during spring and summer of 1993-1995 at the Starkey Experiment Station to evaluate an elk-road density habitat effectiveness model. Elk locations were collected every 3-5

hours. Only 3% of the study area was ≥ 1.1 miles from a road; so authors acknowledged utility of results at greater distances were limited. Habitat selection by elk in spring and summer increased with increasing distance from an open road as expected. However, habitat effectiveness, the percentage of available habitat that is useable outside of hunting season, was affected more strongly by the spatial pattern of roads than by simply road density. Authors simulated road distribution patterns considering these results to demonstrate roads clumped at almost 5 miles/mile^2 retained an unroaded block (232 acres) >3 times larger than the same size area with roads distributed in a regular pattern at 3 miles/mile^2 (77 acres).

Friar, J.L., E.H. Merrill, H.L. Beyer, and J.M. Morales. 2008. Thresholds in landscape connectivity and mortality risks in response to growing road networks. J. App. Ecol. 45:1504-1513.

Friar and other researchers used GPS collar data from 23 cow elk collected every 2 hours during the summers of 2001-2004 to develop and test models of habitat use in relation to publicly open roads without the influences of the popular hunting season pressure or winter snow depths. Authors noted; however, that first nations hunted year-round and 67% of the cow harvest occurred from June-September. Open road density ranged from 0.2 – 1.41 miles/mile^2. Data indicated elk became increasingly selective for clearcuts, a preferred habitat, with increasing distance from roads and consistently avoided conifer habitat regardless of road distance. Authors determined the most rapid changes in elk use occurred at low road densities of 0.4-0.8 miles/mile^2. In some circumstances, mortality risk accelerated substantially at >2.0 miles/mile^2. At average road density of 2.57miles/mile^2, there were no refuges from road effects to elk on the landscape (areas >0.62 miles from a road). Authors noted design of the road network, not strictly density, accounted for ≤30-55% difference in mortality risk and emigration rate. Authors determined "When foraging habitat was abundant, developing roads away from forage patches (clearcuts) created opportunities for elk to readily move among patches without encountering roads, thus reducing their mortality risk and increasing their retention in the landscape." They found that these roads effects extended for 700m from the road. Authors concluded that road densities ≤0.8 miles/mile^2 yielded the highest probability of elk occurrence in a hunted population.

Irwin, L.L. and J.M. Peek. 1979. Relationship between road closures and elk behavior in northern Idaho. Pages 199-204 *in* M.S. Boyce and L.D. Hayden-Wing, eds. North American Elk: Ecology, Behavior and Management. University of Wyoming, Laramie, Wy. 294pp.

During 3 years of hunting seasons, hunters displaced elk from preferred areas to areas with similar but more extensive habitat. Elk moved into dense cover more often during hunting season. Road closures allowed elk to remain in preferred areas longer. Dense stands of timber >30 ha (74 acres) were not large enough to hold elk if open roads were nearby. Smaller stands provided security for elk for several more days if adjacent roads were closed. Elk remained within traditional areas the longest in the largest road closure area, 75 km^2 (28.9 mi^2), closed for the 1977 hunting season.

Gratson, M.W. and C.L. Whitman. 2000. Road closures and density and success of elk hunters in Idaho. Wildl. Soc. Bull. 28(2):302-310.

Gratson and Whitman studied the relationship between open road density, hunter density, and bull elk harvest success rates during 1992-1995 in 3 areas of varying open road density: 2.48 miles/mile^2, 0.9 miles/mile^2, and 0.37 miles/mile^2. Authors provided information that suggested road closures in the managed road density area caused some hunters to move to the high road density area. Hunter density was 1.48mi^2 with 14.8% success in the high road density area, 0.36 hunters/mi^2 with 24.4% success in a managed road density area, and 0.46 hunters/mi^2 with 24.8% success in the low road density area. The low road density area had the highest elk and bull density, 17 and 3.6 animals/mi^2, respectively. The high road density area had the lowest elk and bull density, 3.4 and 0.3 animals/mi^2, respectively. Authors concluded that road closures increased elk use of the less roaded area and also aided hunter success rates by providing quiet access. Authors also noted a 15-20% greater hunting season survival rate for bull elk compared to the highly roaded area. Additionally, interviews of hunters in the study indicated lifetime harvest success rates were higher for hunters who chose to use the managed road access area versus hunters who chose to use the highly roaded area. Authors suggested "hunter densities will decline and success rates may increase in road closures compared to roaded areas" and "road closures may be appealing to wildlife management agencies and the public because hunting opportunity remains relatively great compared to limiting numbers of hunters by controlled hunts or reducing season length".

Proffitt, K.M., J.A. Gude, K.L. Hamlin, and M.A. Messer. 2013. Effects of hunter access and habitat security on elk habitat selection in landscapes with a public and private land matrix. J. Wildl. Manage. 77(3):514-524.

Proffitt et al. (2013) investigated relationships among elk habitat security areas (Hillis et al. 1991), public/private land matrix, and hunter access. Eighty-two cow elk were monitored 1 month pre-hunting, archery, rifle, and 1 month post-hunting in three years (2005, 2006, 2009). Authors determined cow elk selection for areas with restricted public hunting access (private land without public access) was stronger than selection for security habitat. Density of open roads was the strongest predictor of elk distribution. Authors suggested that motorized road access management may be successful at maintaining elk distribution on publicly owned lands. Increased selection for private land occurred during the rifle season; selection was not consistent during the archery season. Elk strongly selected for areas with less open roads during the entire study period and selection away from roads was strongest during the rifle season. Cow elk were less likely to occupy security areas during the rifle and post- hunt periods than the pre-hunt and archery periods. Authors acknowledged security areas were not important to cow elk with the availability of private land refuges and security habitat might be more important when these refuges are lacking. The authors conclude by stating "…management of motorized road access by land management agencies may influence female elk distributions onto public lands during the hunting periods. If these strategies are successful, and provided that adequate elk forage is available on public lands, publicly managed security areas may become a more central part of adult female elk habitat use during hunting seasons than we documented here".

Hillis, J. M., M. J. Thompson, J. E. Canfield, L. J. Lyon, C. L. Marcum, P. M. Dolan, and D. W. McCleerey. 1991. Defining elk security: the Hillis paradigm. Pages 38-43 in A. G. Christensen, L. J. Lyon, and T. N.

Lonner, compilers., Proceedings of the Elk Vulnerability Symposium, Montana State Univ., Bozeman. 330 pp.

Hillis et al. (1991) indicated that bull elk vulnerability can be reduced and hunter opportunity can be increased by providing security areas for elk during the hunting season. To provide a reasonable level of bull survival, security areas were defined as nonlinear blocks of hiding cover > 250 acres in size and > ½ mile from any open road. Security areas should cover at least 30% of an analysis unit to decrease bull vulnerability. Topography, vegetation density, and road access should be considered in this guidance. These are considered minimums and not goals to achieve. These are general guidance for comparisons and not intended for strict application. Rounded polygons are better than linear polygons. The ½ mile reduces and disperses hunter pressure, which concentrate along roads. Security areas should be dispersed across the analysis unit. Cover can include regenerated clearcuts within larger cover blocks. Higher densities of closed roads require greater distances from open roads to achieve elk security.

Canfield, J.E. 1991. Applying radiotelemetry data to timber sale effects analysis in the Harvey-Eightmile drainages in West-central Montana. Pages 44-54 in A. G. Christensen, L. J. Lyon, and T. N. Lonner, compilers., Proceedings of the Elk Vulnerability Symposium, Montana State Univ., Bozeman. 330 pp.

Canfield indicated that in an area with isolated security areas comprising about 23% of the area, elk moved to the protection of private land soon after the start of the rifle season. These elk moved to adjacent private land where hunting was not allowed. In contrast, an adjacent National Forest area containing 34% security habitat "appeared adequate for holding elk". Relatedly, elk were an average of ≤0.7 miles from roads in 2 areas before rifle hunting season but moved to ≥1.24 miles from roads after the opening of the rifle season into large blocks of continuous canopy cover(Figure 4), a significant change.

Edge, W.D. and C.L. Marcum. 1991. Topography amelioriates the effects of roads and human disturbance on elk. Pages 132-137 in A. G. Christensen, L. J. Lyon, and T. N. Lonner, compilers., Proceedings of the Elk Vulnerability Symposium, Montana State Univ., Bozeman. 330 pp.

Authors tracked 39 cow elk from 1980-1983. They found that elk use was lower in areas without topographic barriers to roads. Similar results were documented for topography relative to distances from human disturbance. They also determined that high traffic roads (similar to Level 3 or higher roads) decreased the probability of elk use compared to low traffic roads (similar to Level 2 roads).

Lyon, L.J. and J.E. Canfield. 1991. Habitat selections by Rocky Mountain elk under hunting season stress. Pages 99-105 in A. G. Christensen, L. J. Lyon, and T. N. Lonner, compilers., Proceedings of the Elk Vulnerability Symposium, Montana State Univ., Bozeman. 330 pp.

Authors studied 12 to 20 radio-collared mature bull or cow elk annually during 1985 – 1988 before and during the hunting season. There were 2.39 miles of road/mi^2 in the area, including closed roads. Habitats used by elk during hunting season were characterized by at least a 30% lower density of open roads (0.91 - 0.51 mi/mi^2). Relatedly, authors determined that adequate security was available where elk could access minimum communities of vegetation of 230 acres while the average size community available was 125 acres. These authors concluded that "where elk management objectives include maximizing hunting season length, minimizing restrictions, and maintaining a reasonable branch-

antlered bull component, it will become essential that habitat components contributing to security be identified, described, and maintained".

Leptich, D.J. and P. Zager. 1991. Road access management effects on elk mortality and population dynamics. Pages 126-131 *in* A. G. Christensen, L. J. Lyon, and T. N. Lonner, compilers., Proceedings of the Elk Vulnerability Symposium, Montana State Univ., Bozeman. 330 pp.
Lepitch and Zager found a strong inverse relationship between bull elk survival during hunting season and road density. They found mortality rates of bull elk were 61.7% in an area with an open road density of 4.5 miles/mile^2 and 31.3% in an area with an open road density of 1.0 miles/mile^2. No bulls lived longer than 5.5 years within the high road density area and only 5% lived to maturity (4.5 years). In the "unroaded" area (1 mi/mi^2), some bulls (2%) lived >10 years and 31% of the bulls were mature bulls. The highly roaded area contained <10 bulls:100 cows and 1.3 mature bulls:100 cows. The unroaded area contained 34.5 bulls:100 cows and nearly half were mature bulls. Finally, restricting access through road closures and seasonal road closures in part of the high road density area increased bull ratios from 10:100 to 20:100.

Hurley, M.A. and G.A. Sargeant. Effects of hunting and land management on elk habitat use, movement patterns, and mortality in western Montana. 1991. Pages 94-98 *in* A. G. Christensen, L. J. Lyon, and T. N. Lonner, compilers., Proceedings of the Elk Vulnerability Symposium, Montana State Univ., Bozeman. 330 pp.
Hurley and Sargeant tracked 88 elk from 1984 – 1990. During hunting season, elk in higher open road density areas (1.77 and 3.7 mi/mi^2) increased use of cover and decreased use of open areas while elk in low open road density areas (>1.24 miles from a road) did not change habitat use. Closure of spur roads in the partial road closure area (1.77 mi/mi^2 open roads) did not reduce displacement of elk. Ninety-four percent of bull mortality was due to harvest. Authors found elk harvest was much higher in the higher open road density area (43%) even though most elk (86%) were located in the roadless and road closed areas. Harvest mortality of 2.5 year old bulls was especially high (60%), which the authors attributed to their larger home ranges and their tendency to disperse longer distances into unfamiliar areas. These results for 2.5 year old bulls suggested to the authors that protection of yearlings may not be an effective strategy for increasing recruitment of mature bulls into the population. Authors concluded "restricting motor vehicle access may be an effective means of reducing elk vulnerability, but road closures must encompass larger areas to be effective."

Unsworth, J.W. and L. Kuck. 1991. Bull elk vulnerability in the Clearwater drainage of North-central Idaho. Pages 85-88 in A. G. Christensen, L. J. Lyon, and T. N. Lonner, compilers., Proceedings of the Elk Vulnerability Symposium, Montana State Univ., Bozeman. 330 pp.
Unsworth and Kuck (1991) monitored 101 bull elk over 5 hunting seasons. They found that annual bull survival (0.78) was much higher in unroaded areas (<0.5 mi. road/mi.^{2}) than annual bull survival (0.41) in highly roaded areas (>4 mi. road/mi.^{2}). Bulls in roaded areas preferred thicker timber cover, while bulls in unroaded areas used open timber more often.

Montgomery, R.A., G.J. Roloff, and J.J. Millspaugh. 2013. Variation in elk response to roads by season, sex, and road type. J. Wildl. Manage 77(2):313-325.

Researchers radio-collared 28 elk in Custer State Park (112 mi^2) over several years to determine habitat use and effects of 64 miles of paved roads open year-round, 51 miles of dirt roads open during summer and fall, and 267 miles of unmaintained roads closed to the public year-round except for game retrieval during hunting season. Bulls used home ranges near roads without vehicle traffic in winter, spring, and fall. Bulls reduced their use of habitat that was visible from open roads or close to open roads in summer. Cows responded similarly in spring and fall, during calving and breeding. In spring and summer, cows selected habitat near roads that were closed to traffic. Also during spring, cows selected high quality forage that was not visible from secondary roads. In general, elk selected areas away from primary and secondary roads (those with the highest traffic levels) and near roads closed to public vehicle traffic. These points are particularly important because the high road density (>1 mi open road/mi^2) in the Park made it difficult for elk to avoid roads completely.

Shively, K.J., A.W. Alldredge, and G.E. Phillips. 2005. Elk reproductive response to removal of calving season disturbance by humans. J. Wildl. Manage. 69(3):1073-1080.

Shively et al. (2005) monitored over 140 cow elk over 5 years for reproductive success in relation to human disturbance during calving season. Authors observed reduced productivity in treatment group elk during disturbance years. Elk in the disturbance area increased productivity in the year after disturbance ceased. Productivity among these elk recovered fully by the second post-disturbance year. Elk in the control group maintained similar productivity throughout the 5 years.

Basile, J.V. and T.N. Lonner. 1979. Vehicle restrictions influence elk and hunter distribution in Montana. J. Forest. 77:155-159.

Basile and Lonner determined hunters spent more time walking, saw more elk, and experienced greater harvest success in areas with travel restrictions. In the study area comprised of substantial open habitat, elk left the area during the opening weekend of hunting when road travel was unrestricted but elk remained in the area during the entire hunting season when road travel was restricted to a few major roads.

Freddy, D. J., W. M. Bronaugh, and M. C. Fowler. 1986. Response of mule deer to disturbances by persons afoot and snowmobiles. Wildl. Soc. Bull. 14:63-68.

Snowmobile use elicited a low level response (mild alert response) at a greater distance than person on foot (>450m v. >325m, respectively). However, persons on foot elicited a high level response (movement away) at a greater distance than snowmobile use (>175m v. >125m). Mule deer moved an average of 907 m from foot traffic and 158 m from snowmobiles in high level responses. Distance at which a high level response was elicited increased with more frequent interactions with mule deer, suggesting mule deer became more sensitive to disturbances. Mule deer expended an estimated 2-4% of their daily energy (ME) when fleeing from persons and 0.4-0.8% of their daily energy when fleeing from snowmobiles. Minimizing all levels of response by mule deer would require walkers and snowmobiles to remain >334m and >470m from deer, respectively. Preventing movement responses by mule deer would require persons on foot and snowmobiles to remain >191m and >133m from mule deer, respectively.

Yarmoloy, C., M. Bayer, and V. Geist. 1988. Behavior responses and reproduction of mule deer, Odocoileus hemionus, does following experimental harassment with an all-terrain vehicle. Canadian Field-Naturalist 102(3):425-429.

Mule deer were habituated to ATV use for 12 weeks. Then, a subsample was pursued with an ATV for 9 minutes/day for 15 of 25 days in October 1981. Harassed deer shifted feeding to darkness, used cover more frequently, left home ranges more often, increased flight distance, and produced fewer fawns the spring following harassment. Harassed deer had normal fawn production the year before and the year after the study.

Wisdom, M. J., N. J. Cimon, B. K. Johnson, E. O. Garton, and J. W. Thomas. 2005. Spatial Partitioning by Mule Deer and Elk in Relation to Traffic. Pages 53-66 in Wisdom, M. J., technical editor, The Starkey Project: a synthesis of long-term studies of elk and mule deer. Reprinted from the 2004 Transactions of the North American Wildlife and Natural Resources Conference, Alliance Communications Group, Lawrence, Kansas, USA.

Wisdom and others found that mule deer generally used habitat closer to open roads than elk. However, mule deer were farther than elk from roads that had low traffic rates or were closed, especially at night. Authors speculated that interference competition was occurring with smaller sized mule deer displaced to habitats closer to roads by larger sized and more gregarious elk. Authors noted that elk moved closer to roads (-227 yards) while mule deer moved farther from roads (+388) during a 1 month archery season that prohibited harvest within 400 yards of a road.

Webb, S.L., M.R. Dzialak, K.L. Kosciuch, and J.B. Winstead. 2013. Winter Resource Selection by Mule Deer on the Wyoming–Colorado Border Prior to Wind Energy Development. Range. Ecol. And Mngt. 66(4):419-427.

Webb and others monitored 19 mule deer does with GPS locations every 3 hours over 2 winters to determine to identify important areas of habitat use. They determined, among other conclusions, that mule deer avoided roads during active (0600-1800) and nonactive periods (2100-0300).

Anderson, E.D., R.A. Long, M.P. Atwood, J.G. Kie, T.R. Thomas, P. Zager, and R.T. Bowyer. 2012. Winter resource selection by female mule deer *Odocoileus hemionus*: functional response to spatio-temporal changes in habitat. Wildlife Biology 18:153-163.

Anderson and other researchers compared changes in mule deer habitat use in 2 time periods: (1985-1986) and (2007-2009). Mule deer were found to avoid open roads in 2007-2009. For 2007-2009, probability of habitat selection increased by an average of 5.7% for every 100m increase in distance to the nearest road. Authors attributed some of this difference to the fact that heavily used agricultural fields declined substantially over time and the remaining fields were farther from roads than were all agricultural fields as an average in 1985-1986.

Rost, G.R. and J.A. Bailey. 1979. Distribution of mule deer and elk in relation to roads. J. Wildl. Manage. 43(3):634-641.

Rost and Bailey evaluated elk and mule deer use of habitats within 400m of roads on either side of the Continental Divide in Colorado. Sites west of the Divide were often characterized by greater snowfall

and accumulation which might result in more restricted availability of winter habitat. Deer and elk avoided areas within 200m of roads, especially east of the Divide where winter habitats were more available. Deer avoided higher traffic roads more than elk.

Ward, A.L. (undated). Multiple use of timbered areas: views of a wildlife manager specifically for elk and mule deer. USDA Forest Service, Rocky Mountain Experiment Station, Laramie, Wy. 24 pp.
Ward (undated) stated that foraging areas such as parks, meadows, and clearcuts must be protected from human disturbances such as vehicles and pedestrians. Elk prefer a buffer zone of 800m from pedestrians and 400m from moving traffic; mule deer prefer 180m from pedestrians and 90m from moving traffic. These distances may increase on winter ranges where timber is not accessible for cover. Most disturbing is traffic that is slow moving and where people are more apt to stop and get out of vehicles when they see animals.

Ward, A.L. 1984. The response of elk and mule deer to firewood gathering on the Medicine Bow Range, Pages 28-40 *in* southcentral Wyoming in Proceedings of the 1984 Western states and Provinces elk workshop. Edmonton, Alberta.
Ward found elk and mule deer on the Medicine Bow National Forest were more disturbed by people in activities outside of their vehicles than traffic or equipment. Elk preferred to be at least ½ mile from people engaged in out-of-vehicle activities such as camping, picnicking, fishing, and harvesting timber.

Ward. A.L. 1985. Elk Movements on the North End of the Sierra Madre Mountains. Unpubl. Report. 40 pp.
Ward stated elk on the Medicine Bow National Forest stay about ½ mile from people walking on summer and winter ranges where there is an adequate supply of trees for security cover. Elk may be disturbed at greater distances, possibly 2 to 3 miles, on winter ranges where there are no trees.

Ward, A.L. 1985a. Study of Elk in the Little Snake River Known Recoverable Coal Resource Area (KRCRA) of Southcentral Wyoming. Final Report. USDA Rocky Mountain Forest and Range Experiment Station. Laramie, WY. 188 pp.
Ward studied elk in the Sierra Madre Mountains of southcentral Wyoming. He found that elk had a preference for timbered areas with lower road density or impossible roads due to snow depths or mud. The road itself was not a problem but the human activities associated with the road were the major concern for the welfare of the elk. Ward found 89% of radio-collar elk locations were $\geq$ ¼ mile from a road and 73% of locations were > ½ mile from roads in the Sierra Madres during hunting season.

Gavin, S.D. and P.E. Komers. 2006. Do pronghorn (Antilocapra americana) perceive roads as a predation risk? Can. J. Zool. 84:1775-1780.
Gavin and Komers (2006) determined pronghorn spent less time foraging and more time in vigilant behavior near high traffic roads than lower traffic roads and pronghorn close to roads spent less time foraging and more time in vigilant behavior regardless of traffic volume.

Canfield, J.E., L.J. Lyon, J.M. Hillis, and M.J. Thompson. 1999. Ungulates. Pages 6.1-6.25 *in* Joslin, G. and H. Youmans, coord. 1999. Effects of Recreation on Rocky Mountain wildlife: A Review for

Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society. 307 pp.

Canfield and others reviewed many studies of human caused disturbance to ungulates. The summary of this review could be stated as human disturbance, particularly motorized vehicles, cause disturbance to bighorn sheep, elk, pronghorn, moose, and mule deer throughout the year, but especially during winter.

Geist, V. 1971. Mountain sheep: a study in behavior and evolution. University of Chicago Press, Chicago, Illinois. 383 pp.
Geist (1971) found bighorn sheep to retreat from loud noises caused by recreationists, assuming this behavior to be an innate response to rockfalls and avalanches.

Hutto, R.L. 1995. Composition of bird communities following stand-replacement fires in northern Rocky Mountain conifer forests. Conservation Biology 9(5): 1041-1-58.
Hutto (1995) found that brown creepers and golden-crowned kinglets were more than twice as likely to occur more than 100m from roads than adjacent to roads.

Ortega, Y.K. and D.E. Capen. 2002. Roads as edges: effects on birds in forested landscapes. Forest Science 48(2):381-390.
Ortega and Capen (2002) found 4 of 18 forest interior bird species had lower relative abundance or territory density adjacent (<150m) to unpaved roads while 4 of 6 edge nesters had higher relative abundance near unpaved roads. Their results suggested that narrow openings within forested landscapes may affect habitat use.

Berry, K.H. 1980. A review of the effects of off-road vehicles on birds and other vertebrates. In: Workshop Proceedings: Management of Western Forests and Grasslands for Nongame Birds. USDA Forest Service. GTR-INT 86. Intermountain Forest and Range Experiment Station, Ogden, UT.

Berry determined bird species abundance and diversity were lower within a heavy ORV use area compared to a low ORV use area. There were also declines in bird abundance and variety in each of these areas when ORVs were present compared to when ORVs were not present.

Richardson, C.T. and C.K. Miller. 1997. Recommendations for protecting raptors from human disturbance: a review. Wild. Soc. Bull. 25(3):634-638.

Richardson and Miller summarized that birds of prey are impacted by human activities in 3 ways: physical harm or death, habitat alteration, and behavior disruption. They noted that “even brief absence by parent birds can lead to missed feedings, predation on eggs or young, or to overheating, chilling, or desiccation of eggs or young”. They recommended spatial and temporal buffers to reduce impacts.

Mutter, M., D.C. Pavlacky, N.J. Van Lanen, and R. Grenyer. 2015. Evaluating the impact of gas extraction infrastructure on the occupancy of sagebrush obligate songbirds. Ecol. Apps. 25(5):1175-1186.

Mutter and other researchers evaluated the effect of roads and natural gas well pad development on sagebrush obligate Brewer's sparrow, sagebrush sparrow, and sage thrasher. Researchers determined that, at the landscape scale, sagebrush sparrow and sage thrasher occupancy decreased with increasing road density but increased with well density. Authors speculated that Brewer's sparrow showed no response to development because these sparrows have the smallest territory size of the 3 species. Authors speculated that all 3 species did not respond to well pad development because sagebrush dependent birds are known to have high site fidelity even if habitat fragmentation reduces productivity. So, well pad impacts would not be apparent for several years.

Ingelfinger, F. and S.H. Anderson. 2004. Passerine response to roads associated with natural gas extraction in a sagebrush steppe habitat. W. N. Am. Natrlst. 64(3):385-395.

Authors determined that densities of Brewer's and sage sparrows were reduced by 39%-60% within 100m of low traffic volume roads. Authors speculated traffic volume alone may not explain all declines and birds may have also responded to edge effects, fragmentation and increases in other passerines along the roads. Therefore, declines might persist if traffic subsides until roads are fully reclaimed.

Gutzwiller, K.J., R.T Wiedenmann, K.L. Clements, and S.H. Anderson. 1994. Effects of human intrusion on song occurrence and singing consistency in subalpine birds. Auk 111(1):28-37.

Gutzwiller and others completed sonbird surveys in circular plots during 1989-1991 on the Brush Creek-Hayden District. Plots were 0.4km from roads and none were located within recent, on-going, or near future timber harvest units. Intrusion treatments were defined as walking through a plot for 1-2 hours, 1-2 times a week for 10 weeks from late May through early August. They found that intrusion had only small impacts on song occurrence for a few species. They found that singing consistency was reduced by intrusion for several species in 1989 and 1990. Authors speculated that because "song is essential in territory defense, mate acquisition, and in other reproductive activities, levels of intrusion that alter normal singing behavior have the potential to lower the reproductive fitness of males that are sensitive to this form of disturbance".

Robitaille J.F. and K. Aubry. 2000. Occurrence and activity of American martens *Martes americana* in relation to roads and other routes. Acta Theriologica 45: 137-143.
Authors monitored marten tracks in snow at distances from a highway, open roads, and powerline access routes. Martens did not avoid roads. However, marten tracks were much more common away from roads. Given the low density and territorial nature of martens, this suggests individual martens were more active away from roads.

Oxley, D.J., M.B. Fenton, and G.R. Carmody. 1974. The effects of roads on populations of small mammals. J. Appl. Ecol. 11(1):51-59.

Oxley and others found that only 10 of 78 small rodents trapped adjacent to low volume (5 vehicles/hr.), narrow roads eventually crossed those roads. No small rodents crossed road corridors wider than

14.6m (48 ft.) They found road crossings declined substantially for medium-sized mammals (snowshoe hare size) when road corridor width increased from 11 to 14.6m (36 to 48 ft.) to 19 to 27m (62 to 88 ft.).

Gibbs, J.P. 1998. Amphibian movements in response to forest edges, roads, and streambeds in southern New England. Journal of Wildlife Management 62(2):584-581.

Gibbs (1998) determined roads are an important anthropogenic landscape feature hindering amphibian movements. Roads caused substantially reduced movement levels compared to forest-residential edges. It was unknown whether the difference in edge permeability was due to a behavioral avoidance of road edges or elevated mortality associated with road crossing. The author surmised the lack of road crossings was concerning because dispersal of recently metamorphosed juveniles across even open upland habitats is important to reach breeding pools.

Fahrig L, Pedlar JH, Pope SE, Taylor PD and Wegner JF. 1995. Effect of road traffic on amphibian density. Biological Conservation 73:177-182.
Fahrig and others evaluated amphibian abundance near high use roads with 3 levels of intensive use. Authors determined that "the number of dead and live frogs and toads per km decreased with increasing traffic intensity; the proportion of frogs and toads dead increased with increasing traffic intensity; and the frog and toad density, as measured by the chorus intensity, decreased with increasing traffic intensity. Taken together, our results indicate that traffic mortality has a significant negative effect on the local density of amphibians."

Carr, L.W. and L. Fahrig. 2001. Effect of road traffic on two amphibian species of differing vagility. Conser. Bio. 15(4):1071-1078.
Carr and Fahrig evaluated the abundance of leopard frogs (very mobile) and green frogs (daily more sedentary) at 30 breeding ponds in relation to traffic density. Researchers found that leopard frog population density was reduced by traffic density within 1.5 km. They found no evidence that green frog populations were affected at any scale. They concluded that traffic mortality can cause population declines and more mobile species are more vulnerable to road mortality.

Nash, R.F., G.G. Gallup, Jr., M.K. McClure. 1970. The immobility reaction in leopard frogs (Rana pipiens) as a function of noise-induced fear. Psychon. Sci. 21(3):155-156.
Nash and others found that leopard frogs exposed to a loud noise (120 dB) were immobile for a much longer time (97 sec.) compared to a control group (12 sec).

Maxell, B.A. and D.G. Hokit. 1999. Amphibians and reptiles. Pages 2.1-2.29 *in* G. Joslin and H. Youmans, cords. Effects of recreation on Rocky Mountain wildlife: A review for Montana. Committee on effects of recreation on wildlife, Montana Chapter of The Wildlife Society. 307pp.

Maxell and Hokit recommend no construction of new recreational facilities, roads, or trails within 300m of key amphibian breeding, overwintering, or foraging sites due to habitat loss, habitat fragmentation,

habitat degradation and contamination, movement barriers, increased disturbance, increased mortality, and promotion of non-native species.

Vos, C.C. and J.P. Chardon. 1998. Effects of habitat fragmentation and road density on the distribution pattern of the moor frog Rana arvalis. J. App. Ecol. 35(1):44-56.

Vos and Chardon evaluated 109 ponds and concluded that the size of moor frog populations was negatively associated with the density of paved road systems around ponds, particularly within 250m. Secondly, density of roads within 750m was associated with the probability of whether a pond would be occupied by moor frogs.

Bury, R.B., R.A. Luckenbach, and S.O. Busack. 1977. Effects of off-road vehicles on vertebrates in the California desert. Wildlife Research Report 8. Wash. D.C., Fish and Wildlife Service. 23pp.
Bury et al. (1977) found that ORV-use areas have significantly fewer species of vertebrates, greatly reduced abundance of individuals, and noticeably lower reptile and small mammal biomass. Diversity, density, and biomass of reptiles and small mammals were inversely related to the level of ORV usage.

Joslin, G. and H. Youmans, coordinators. 1999. Effects of recreation on Rocky Mountain wildlife: A review for Montana. Committee on effects of recreation on wildlife, Montana chapter of The Wildlife Society. 307pp.
Joslin and Youmans amassed extensive literature concerning the effects of roads and recreation on wildlife. They summarized that roads generally eliminated habitat, reduced habitat quality, changed habitat use, increased non-natives, increased pollutants, increased stressors, reduced fitness, reduced productivity, reduced abundance or distribution, and increased mortality. They reviewed research on amphibians and reptiles, birds, small mammals, semi-aquatic mammals, ungulates, carnivores, and vegetation/soils.

Hamman, B., H. Johnston, P. McClelland, S. Johnson, L. Kelly, and J. Gobielle. 1999. Birds. Pages 3.1-3.34 *in* Joslin, G. and H. Youmans, coords. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society. 307 pp.
Greater human dispersal provided by roads may also reduce the amount of snags and down and dead material since motorized access facilitates firewood collection and cutting (Hamann et al. 1999). These researchers suggested that firewood cutting was in direct conflict with woodpecker nest success because woodcutters harvested the material most valuable to woodpeckers for nesting (large standing snags…).

Tinker, D.B., C.A. Resor, G.P. Beauvis, K.F. Kipfmueller, C.I. Fernandes, and W.L. Baker. 1998. Watershed analysis of forest fragmentation by clearcuts and roads in a Wyoming forest. Land. Ecol. (13) 149-165.
Tinker et al. (1998) found roads were a more significant agent of change to the landscape than clearcuts in the Bighorn National Forest by decreasing patch size, increasing patch density, increasing edge, and simplifying patch shape. The effect of road edges may extend more than 50 meters into the adjacent

forest. Edges created by roads and clearcuts are different from edges created by natural events such as fire because road created edges are abrupt.

Reed, R.A., J. Johnson-Barnard, and W.L. Baker. 1996. Contribution of roads to forest fragmentation in the Rocky Mountains. Conserv. Biol. 10:1098-1106.

Reed et al. (1996a) studied the Tie Camp area immediately west of the Blackhall Mountain. They found that roads added to forest fragmentation more than clearcuts by creating smaller patches, more patches, and converting interior habitat to edge habitat. Roads increased the number of patches by 179% and decreased patch size by 65% since 1950. Roads increased the distance between patches of interior habitat. Whereas natural and clearcut patches become progressively less defined, road edges exist long term and are more frequently disturbed.

Forman, R.T.T., Friedman, D.S., Fitzhenry, D., Martin, J.D., Chen, A.S., Alexander, L.E. 1997. Ecological effects of roads: Toward three summary indices and an overview for North America. In: Canters, K., Piepers, A., Hentriks-Heersma, D. (Eds.), Habitat Fragmentation and Infrastructure. Ministry of Transport, Public Works and Water Management, Delft, Netherlands . pp 40–54.

These researchers determined that roads impart ecological effects that can be represented by 3 variables: road density, road location, and road effect zone. They surmised some road density effects to wildlife can be reduced in areas with moderately high road density but that contain roadless areas. Researchers indicated roads effects such as chemical, mineral, or sediment transport, bird and mammal distribution, invasive species, and human disturbance can extend from 100m to 1000m from the road edge.

Coffin, A.W. 2007. From roadkill to road ecology: A review of the ecological effects of roads. J. Transportation Ecology 15:396-406.

A summary of others' research concluded roads have biotic and abiotic impacts to the land and road networks can render the landscape as isolated patches of habitat within the road influenced matrix.